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ABSTRACT

This technical report is the companion volume to the 1975 Databook, the purpose of which was the compilation of available data series focused on the organization and functioning of the knowledge production and utilization (KPU) system. This technical report is intended to (1) provide more accurate data sources, (2) analyze existing data sources, and (3) consider how an ideal set of indicators would be accumulated for monitoring the KPU system. Chapter one is an introduction. Chapter two sketches the development of the social indicators movement, reviews the limitations and potential of an indicator approach for monitoring systems, summarizes the indicators used to monitor "education" as one component of the social system, and discusses the relevance and utility of this approach for monitoring KPU. Chapter three concentrates on the development of a model of educational KPU from which a set of indicators for monitoring can be derived. It also relates a model of educational KPU to the data available for the 1975 Databook. Chapter four presents the general difficulties encountered in data collection and analysis and presents a strategy for minimizing or avoiding these difficulties in the future. Chapter five contains a critique of each data series included in the Databook. The last chapter of this report summarizes the conclusions reached and recommendations made in the preceding chapters and offers some alternative approaches for data collection, analysis, and presentation. (DMT)

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MONITORING THE STATUS OF EDUCATIONAL RESEARCH AND DEVELOPMENT IN THE UNITED STATES

TECHNICAL REPORT

to accompany

1975 DATABOOK

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1. INTRODUCTION

In its major position paper, BUILDING CAPACITY FOR RENEWAL AND REFORM (1973), the National Institute of Education recommends "Developing a monitoring system within NIE to systematically and periodically gather and analyze data about the functioning of the knowledge production and utilization system which will provide a base for the continued improvement of the system" (p.63).

The 1975 DATABOOK project is one contribution to the first phase of assembling this data base. Other contributions include a study of the "regulators" of educational R&D conducted by O.W. Markley at the Stanford Research Institute and a study of the roles institutions of education play in knowledge production and utilization.

The central task in preparing the DATABOOK was the compilation of available data series focused on the organization and functioning of the knowledge production and utilization (KPU) system. To accomplish this task it was necessary to continually question the purposes and possibilities of a monitoring system for educational KPU. This technical report is the companion volume to the DATABOOK. In it we share with you the problems we encountered while executing our task and our current understanding of the potential for a KPU monitoring system.

1.A. PURPOSES OF THE TECHNICAL REPORT

Drawing on the experience we have accumulated in preparing the DATABOOK, this technical report is intended to serve several purposes. First, we are in a prime position to analyze existing data sources. Even before our search for information relevant to educational KPU began, it was clear that the quality of existing data was lower than desired. In BUILDING CAPACITY FOR RENEWAL AND REFORM this condition was noted. "... there is a great need for better data concerning the knowledge production and utilization system and the operating school system it serves. To be sure, information is not entirely lacking, but where it exists it is often out-of-date, incompatible with data from other sources, or of questionable validity"(p.65).

Over the past eighteen months we have reviewed hundreds of books, articles, papers and reports as we searched for data series appropriate for the DATABOOK. A draft version of the DATABOOK was circulated in June and July of last year. Comments and suggestions from readers of the draft alerted us to additional data sources. In general, however, the 1973 NIE appraisal of data quality remained correct. We were disappointed by the lack of data series pertinent to monitoring educational KPU as well as by the quality of the information we did uncover.

Exposure to this wide variety of data sources has provided the opportunity to compare and evaluate different approaches to data collection, analysis and presentation. Despite conceptual and methodological shortcomings which compromised the reliability or validity of certain measures, it was possible to accumulate data series for a first approximation of a monitoring system for

educational KPU. In this enterprise we worked with NIE staff of the R&D System Support Division. NIE staff members contributed a knowledge of the information needs of KPU policy makers which complemented the researchers' concern for a "state of the science" report.

Our analysis of the data is intended to address questions raised from both of these perspectives. We have directed our attention to the utility of the data series for monitoring KPU as well as to their methodological quality.

In this report we also make recommendations to improve future monitoring efforts. Recommendations offered fall into one of the following categories:

1. A recommendation for the continued use of a particular data series as it is added to over time.

2. A recommendation for the modification of existing data series which will reshape them according to the needs of the monitoring system. This applies to measures repeated periodically by NIE or other agencies, or to studies still in the planning stages.

3. A recommendation to undertake new data collection on variables that have been measured inadequately for current monitoring purposes.

4. A recommendation for a new model of the KPU system or a new conceptualization of the monitoring system.

5. A recommendation to collect data on variables that were not considered or measured previously.

Recommendations concerning the technical quality of data series were possible once the data had been reviewed and studied. Recommendations for continuation of the monitoring responsibility depended upon the formulation of a model of the KPU system from which significant indicators could be derived.

The DATABOOK was set in the "social indicator" tradition which placed certain constraints on the conceptual model and the empirical data that would be useful for monitoring the KPU system. This approach stresses the system dynamic by employing time series statistics as indicators of the condition and process of the system.

Only by imposing a model upon the KPU system were we able to suggest critical points for monitoring the system. The model presented in Chapter 3 of this report provides the structure for testing many hypotheses on the functioning of the KPU system. It is not intended to nullify other conceptualizations. Rather we expect a thorough discussion of this model in

light of competing proposals. The short term task in the design of a monitoring system that can improve the KPU system over the long term.

1.B. TERMINOLOGY FOR THE TECHNICAL REPORT

Throughout the DATABOOK project it has been difficult to maintain a consistent terminology. We have continually encountered problems in assigning the label "knowledge production and utilization" to a system that more often was referred to and defined as "research and development" or "R&D."

"Research and development" is no longer an accurate or sufficient description of the processes responsible for change in the educational system. Over the past decade we have come to appreciate the role played by diffusion, dissemination, implementation and evaluation of R&D outputs for changing the educational system. The "knowledge production and utilization" or "KPU" terminology was developed in recognition of the importance of these processes.

The monitoring of a system must be comprehensive if the various components are to be treated as a system. The DATABOOK originated as an attempt to monitor the entire system. We therefore set out to collect data on the broader "KPU" system rather than the "R&D" system. As we discuss in Chapter 4 of this report, many obstacles thwarted our attempt.

A major difficulty was presented by the lack of data series covering the KPU system. In general statistics are reported on research and development activities. Rarely did we locate time series statistics sensitive to the broader construct, KPU. The DATABOOK therefore used the "R&D" terminology to represent most of the data series contained in it. In this report we are charged with describing the activities and data that we have already encountered but we must also address issues related to the future. We have employed the KPU terminology to denote the total system to be monitored. Discussions of the individual data series in Chapter 5 cover the validity of the KPU construct as operationalized in the study as well as the utility of the data series for monitoring the comprehensive KPU system.

1.C. ORGANIZATION OF THE TECHNICAL REPORT

The purposes to be served by this report have required us to step back from the data collection experience to consider once again how an ideal set of indicators would be accumulated for monitoring the KPU system.

In Chapter 2 the development of the "social indicators" movement is sketched in. Although this history is recounted thoroughly in other sources (e.g., Land and Spilerman, 1975), it was necessary to review the limitation and potential of an indicator approach for monitoring systems.

A brief summary of the indicators used to monitor "education" as one component of the social system is also included in Chapter 2. A discussion of the relevance and utility of this approach for monitoring KPU concludes the second chapter.

In Chapter 3 we concentrate on developing a model of educational KPU from which to derive a set of revealing indicators for monitoring KPU. We begin by considering the role a model can play in monitoring the system and devote subsequent sections to the evolution of the KPU system and various conceptual models used to describe it. Finally we present a model of educational knowledge production and utilization for the DATABOOK and relate it to the data available for the 1975 DATABOOK.

Chapters 4 and 5 focus in the data series reviewed in the course of preparing the DATABOOK. In Chapter 4 we discuss the general difficulties encountered in data collection and analysis and propose a strategy for minimizing or avoiding these difficulties in the future.

Chapter 5 of the report contains a critique of each data series included in the DATABOOK. Organization of the critiques parallels data presentation in the DATABOOK. Data series considered relevant but inappropriate for the DATABOOK are also reviewed in Chapter 5. Recommendations specific to individual data series are included in the critique. Suggestions for new data series or a new perspective on a particular variable are discussed at the conclusion of appropriate sections.

The last chapter of this report summarizes the conclusions reached and the recommendations made in the preceding chapters. Although we do not review methodological recommendations offered on individual data series, we again suggest some alternative approaches for data collection, analysis and presentation.

2. THE "SOCIAL INDICATORS" APPROACH

Collection and interpretation of social indicators has constituted one of several attempts to monitor our social system. In extending the social indicators approach to the sector of educational knowledge production and utilization, it is useful to consider the recent development of this approach. Cognizant of the limitations noted by other authors (Sheldon and Freeman, 1970; Sheldon and Land, 1972; Land and Spilerman, 1975), we will examine the various definitions and purposes argued for social indicators. Next we will review indicators of educational activity and outcome that have been proposed in the limited set of indicator studies which focused on education. Finally, we will discuss the uses of indicators in monitoring the educational KPU system.

2.A. THE EVOLVING DEFINITION OF SOCIAL INDICATORS

Definitions of social indicators have ranged from loose conceptualizations to restrictive organizations of theoretical constructs and prescriptions. Although the goal of describing the citizenry has been the aim of the census for centuries, the "social indicator movement" has been alive for less than a decade.

SOCIAL INDICATORS, a book of papers edited and discussed by Raymond Bauer (1966), is usually credited with launching this approach. Bauer calls for "continuing statistical series" which allow "comparisons from time to time across societies" (p.21). Albert Liderman, in this same volume, recognizes the need for "quantitative data that serve as indexes to socially important conditions of the society." (p.69)

The original purpose of SOCIAL INDICATORS was to assess second order effects of the space program in the United States. Realizing that assessment was extremely difficult without baseline data on the state of society, the authors proposed a system of "social accounts" modelled after the national economic accounts system. The economic accounts look at total economic activity in two ways: 1) by summing output of goods and services (GNP); and 2) by summing costs and earnings (NNP).

Over the years, discontent with economic indicators has increased. In addition to the internal technical inadequacies of these measures, economic indicators fail to describe the quality of life experienced by the average American. Social indicators are an attempt to describe dimensions of life other than income.

Bertram Gross' contribution to the Bauer book argues for the the construction of comparable measures based on a conceptual model of the social system. He posited a structural-functional model for this purpose and created "intermediate aostractions" of social welfare which emphasized quantifiable economic variables. Thus, for "grand abstractions" such as "peace, security,

freedom, liberty, autonomy, self-determination, and equality," the corresponding "intermediate abstractions" were exemplified by full employment and fair employment (pp.263-265). Although Gross conceded a possible need for more specific indicators, these were also to rely upon economic surrogates when possible.

A "system of social accounts" was also recommended in 1966 by the National Commission on Technology, Automation, and Economic Progress in its report entitled TECHNOLOGY AND THE AMERICAN ECONOMY. Here it was suggested that an effort to parallel national income accounting would provide indications of the "social benefits and social costs of investments and services and thus reflect the true costs of a product..." (pp.96-97).

The indicator/accounts concept was vague and overworked. Terms and concepts proliferated, expectations were inflated, but definition was slow in coming.

In 1968, a distinction between social indicators and social accounts was offered by Wilbur J. Cohen. He suggested that "statistics which indicate clearly and precisely present conditions in our society, including, for example, the magnitude of existing social problems and their rate of change" are social indicators. Social accounts, on the other hand, are "statistics which, given a sense of the problems which exist, can suggest the cost and effectiveness of alternative means of resolving these problems" (p.14).

Consideration of statistical social reporting thus focused on social indicators as a first step. One had to conceptualize social problems and measure them before one could look for solutions.

Perhaps the most restrictive definition of social indicators was offered in TOWARD A SOCIAL REPORT in 1969. This document was issued by HEW in response to an executive request for ways to improve the Nation's ability to chart its social progress. In an attempt to explain the need for new social statistics at a time when critics noted the abundance of unserviceable statistics, the following specifications were proposed for social indicators:

> "A social indicator, as the term is used here, may be defined to be a statistic of direct normative interest which facilitates concise, comprehensive and balanced judgments about the condition of major aspects of a society. It is in all cases a direct measure of welfare and is subject to the interpretation that, if it changes in the 'right' direction, while other things remain equal, things have gotten better, or people are 'better off.' Thus statistics on the number of doctors or policemen could not be social indicators, whereas figures on health and crime rates could be." (p.97)

This definition states widely-held expectations for social indicators but has been criticized for its strict inclusion criteria. Had a well-articulated, well-accepted theory of the social system existed on which to rationalize specific but comprehensive data collection, these would have been reasonable criteria. Lacking such a theory, the reliance on measures of normative outcomes is unwarranted. Inclusion of input indicators and indicators of social process would facilitate the development of new models and theories by providing observations on system dynamics.

Eleanor Sheldon and Howard Freeman (1970) noted this limitation of the definition offered in TOWARD A SOCIAL REPORT and added that the variability of norms over time limited the utility of indicators adhering to this criterion.

In 1971 Kenneth Land proposed the following attributes to differentiate social indicators from other social statistics:

1. They are components of a social system (including sociopsychological, economic, demographic, and ecological) model or of some particular segment or process thereof;

2. They can be collected at a sequence of points in time and accumulated into a time-series; and

3. They can be aggregated or disaggregated to levels appropriate to the specifications of the model (p.323).

Land emphasized the "informative value" a statistic can derive from its location in a particular conceptualization of a social process. He argued that the organizational and distributive consequences of input variables, such as the "number of doctors or policemen" transform expenditures into the output indicators. Without knowledge of these inputs, understanding of social process is inhibited. Granting that Gross (1966) had also attempted to derive social indicators from a model of the social system, Land draws the distinction between the structural-functional model offered by Gross and a model in which causal processes may be described.

Debate over input and output indicators versus strictly output indicators is not resolved. In SOCIAL INDICATORS 1973 (OMB) input indicators were, for the most part, excluded. Statistics were intended to measure "individual and family (rather than institutional or government) well being...in relation to a perceived social objective" (p.xiii).

Discussants of the OMB document at a Review Symposium sponsored by the Social Science Research Council noted the limitations of this formulation (Van Dusen, 1974). Standards were promulgated, if only implicitly, by the output measurements presented and were then subject to disputation and obsolesence. Unwillingness to reach beyond normative data resulted in the omission of social indicators which might eventually prove powerful in describing the system. An example drawn from family welfare was the deletion of statistics on divorce

because of an inability to determine whether an increase in divorce indicates more widespread dissatisfaction with marriage or greater willingness to dissolve an unsatisfactory relationship. When it is not possible to evaluate phenomena as prevalent as divorce, the requirement for normative data is surely too restrictive. Instead, input data disaggregated in various ways as support for, or refutation of, exploratory theories of the social system might be welcomed.

Land's approach is further elaborated in a recent book co-edited with Seymour Spilerman, SOCIAL INDICATOR MODELS (1975). After reviewing the history of social indicators, Land recommends three types of desirable indicators:

1.a. Output Descriptive Indicators: These are measures of end products of social processes and are most directly related to the appraisal of social problems and social policy.

1.b. Other Descriptive Indicators: These are more general measures of the social conditions of human experience and the changes taking place therein.

2. Analytic Indicators: These are components of explicit conceptual models of the social processes which result in the values of the output indicators.

He suggests that "for any particular social condition, social indicators are specified when some conception of the relevant social process is stated" (p.17). A model which specifies the processes that determine social conditions he labels a "social indicator model." The model attempts to measure social conditions without imposing any additional standards for preferred states or optimal functions.

In the area of education Land proposes an exemplary model. He suggests that output indicators would relate to individual learning and attainment. Policy instrument indicators would relate to monetary, personnel, and physical resources committed to educational programs. Descriptive indicators pertaining to family environment and individual abilities would be included as nonmanipulable variables. Side-effect descriptive indicators concerning individual occupational and income attainment, life style, cultural tastes, etc. would complete the model. These indicators are selected because of the role they play in Land's model of the educational sector. It is quite likely, and plausible to Land, that others would recommend additional variables implied by alternative models.

The definitions of indicators have varied not only on theoretical or methodological grounds but also in correspondence to the variety of purposes and roles indicators are expected to perform. In the next section we review briefly the expectations and rationales upon which arguments for "social indicators" are structured.

2.B. EXPECTATIONS FOR SOCIAL INDICATORS

Essential to the term "social indicator" are the concepts "reporting" and "assessment." By reporting we mean conveying information about a state, event or phenomenon from one or several sources to one or several receivers. The "social indicator" approach provides one of numerous vehicles for the transmission of information about social conditions. Though we will not discuss the alternative approaches, a few examples are included in Figure 2.B.1. REPORTING ON THE SOCIAL SYSTEM. The assessment function occurs in terms of the current state of the system (How are we doing?), the direction of development (Where are we heading?), or recommended system modifications (What should we do about it?) as the consequence of reporting. The assessment possibilities suggested for social indicators are grouped horizontally in Figure 2.B.1.

(INSERT FIGURE 2.B.1 ABOUT HERE)

In Figure 2.B.1. we schematically relate most of the rationales, purposes, and roles for social indicators offered during the past ten years. Initially, in such documents as SOCIAL INDICATORS (Bauer, 1966) and TECHNOLOGY AND THE AMERICAN ECONOMY (National Commission on Technology, Automation, and Economic Progress, 1966), a broad system of social accounts was proposed. Comparable to accounts in the economic sector, social accounts or "balance sheets" were expected to assess the social condition. Proponents, such as Daniel Bell (1973), suggested that the costs and benefits of social policy could be determined by these indices. Once available, such information could be useful in future policy settings. This path of assessment stems from (S) or Social Accounts in Figure 2.B.1.

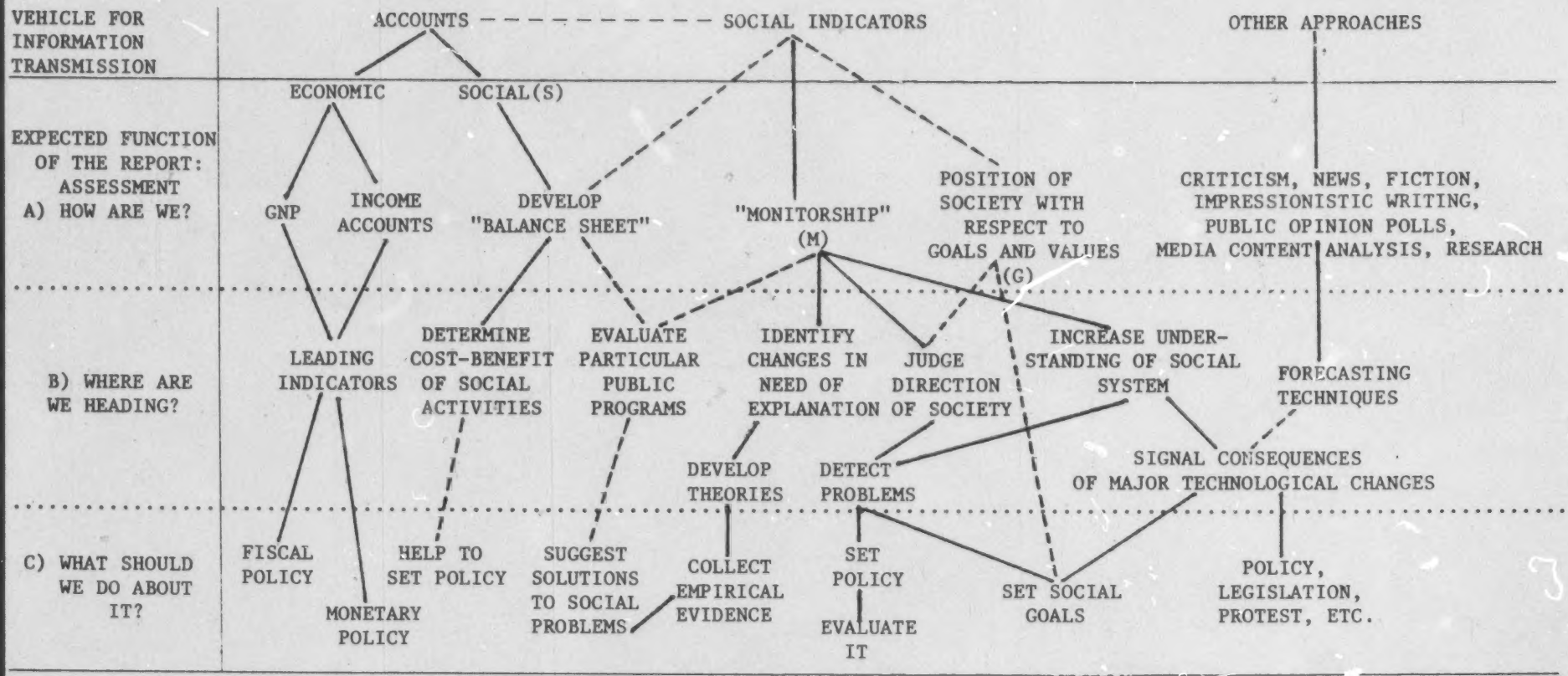
This position has been criticized on several grounds (see above, section 2.A, and Sheldon and Freeman, 1970). It has been argued that analogy with economic indicators called for a cumulative total for social welfare, attainable only if we relied on economic surrogates for the salient variables. Using economic surrogates, however, biases conclusions on the "quality of life" toward objective, economic issues and away from subjective and qualitative concerns. Campbell and Converse presented alternative indicators in THE HUMAN MEANING OF SOCIAL CHANGE (1972) which emphasized the sociopsychological perspective. Indicators of attitudes, aspirations, expectations, values, and use of time were included in their book.

The concept of a "balance sheet" has also been criticized by Sheldon and Freeman (1970) because we lack a single theory of the social system which is mature enough to prescribe the linkages between variables in the system in the same way that economic models prescribe the variables indicative of the economic condition.

If we accept Cohen's proposal (1968) that "social accounts" specify the effective solutions to already delineated problems, construction of a "balance sheet" may be a premature attempt to solve problems before a mechanism to determine the problems is developed.

TECHNICAL REPORT FIGURE 2.B.1

REPORTING ON THE SOCIAL SYSTEM



KEY: Vertical solid lines indicate expectation relationships

Vertical broken lines indicate expectation relationships which have been criticized or challenged.

Sheldon and Freeman (1970) also fault the claim for an active role for social indicators in the formation of public policy. While they do not deny that indicators will be employed to influence policy decisions, they support the views of Henriot (1970) that the development of indicators is itself a sociopolitical and value-laden process in which the impact of the indicator is determined by its place in a particular model of the system. The validity of the indicator is then dependent upon the values inherent in the model rather than intrinsic to the statistic. This would undoubtedly be true unless a value-free system model were possible. In addition to a particular value orientation, every report is limited in its ability to transmit information faithfully due to the imperfect correspondence between the phenomenon and the measure. Bias may be introduced methodologically, theoretically, or subjectively. If policy decisions continue to rest on biased data (as they are likely to do), it is critical that the assumptions and constraints of the model and measures be made explicit.

A third set of expectations was developed around the notion of "monitorship." The monitor requires information about the system operation and change in order to conduct administrative and directive activity. Social indicators, as Eleanor Sheldon and Wilbert Moore suggested, were to supply this information:

> "If an indicator can be found that will stand for a set of correlated changes, and if intervention can be introduced (whether on the prime, indicative, variable, or on one of its systematic components), then the program administrator may have been provided a powerful analytic and policy tool" (Sheldon and Moore, 1968, p.4).

Although change can be verified by comparing the same measurements over time (as social indicators are intended to do), there are several problems implicit in this approach. Further sophistication of theory often shifts the direction of our inquiry to new variables. If the change in perspective is radical, the likelihood of having prior data on variables of current interest is minimal. Acknowledgement of inadequacies in predicting future relevant variables is discouraging. Perhaps comfort can be gained from the realization that inappropriateness of old conceptual models is itself evidence of change in social thinking.

Change in the substance or value of the phenomenon being measured further complicates an assessment of social change. Although we maintain records of the percent of the population graduating from high school, the significance of a high school education varies unrecorded. The material covered in courses, the types of courses offered, and the preparation for employment differ radically today from twenty years ago. These qualitative changes are not currently reflected by indicators of the educational sector.

Such weaknesses in the data do not merit abandonment of the effort. Instead, they give further credence to the need for models of maximum flexibility from which to derive indicators and upon which numerous theories can be examined.

Referring back to Figure 2.B.1, we note four expctations associated with social indicators employed to monitor (M) the social system. Initially, social indicators were thought to be useful in the evaluation of particular social programs. However, as numerous government sponsored programs were enacted in the late 1960's and early 1970's, social indicators proved unsatisfactory for this purpose. Innovative programs required closer surveillance and special techniques to control extraneous variables. Evaluation research has produced experimental and quasi-experimental designs more suited to the measurement of program effects.

Social indicators have also been considered appropriate for judging the quality of society by the direction of change. Land (1975) notes that a judgment of this sort is dependent upon normative measures as specified in TOWARD A SOCIAL REPORT (1969).

As social indicators document change in society, they may add to our understanding of the social system. Patterns of change that emerge unexpectedly can suggest causal relationships not yet considered. In addition, they may aid in the detection of problems or unanticipated second-order effects that signal a need for intervention. It is also possible that changes difficult to explain invite new theory construction. Consequent to this new understanding, policy recommendations may be made.

Explanation of social change is more robust the more directly related it is to a model of the social structure or social process. The development of such models, however, is incremental. Social indicators ideally play a cyclical role in this process. From their location in a model of the social system, they report on changes in the system. As our understanding of the system changes, so we change our conceptualization of the model. This in turn may suggest new locations for indicators. The initial stages of this process, in which we are now engaged, will most likely be awkward, incomplete, and tentative, but are already necessary for marking progress.

Social indicators have also been presented as a means of assessing the position of society with respect to commonly held goals and values (G). This expectation is questionable in light of variation between individuals concerning what goals and values are desirable for American society, as well as discrepancy between the values we espouse and our collective behavior.

In summary, social indicators are seen as a vehicle for reporting on the social system. The report may be accepted as a goal in itself, as a prerequisite for assessment of social change, or as a data base for policy decisions. When indicators are used in policy formation, the implicit values of the model upon which they are based should be made explicit. The utility of input and process indicators varies according to the amount of intervention possible, social norms, performance standards, and the values of policy makers. Returning to the example cited above, an input measure such as size of police force is useful if one can intervene and alter that amount through policy decisions. It is also useful if policy makers are dissatisfied with low crime rates (an outcome indicator) accomplished by employing an exceedingly large percent of the

population to maintain law and order. Thus, indicators need not depend on social norms, but the policy maker studying indicators will impose his/her own values when formulating policy.

The role indicators have played in the educational sector and the applicability of these concepts for the educational research and development system are the focus of our attention in the following sections.

2.C. INDICATORS OF THE EDUCATIONAL PROCESS

Early in the social indicator movement efforts were made to determine the condition of education in the United States. Occasionally the nonformal processes of learning and technological development were included; more often their relevance was overlooked. Statistics on the operation of the formal school system have been maintained for more than a century, but clearly not all qualified as social indicators.

INDICATORS OF SOCIAL CHANGE (1968) contains two chapters relevant to education and learning. In a large paper on "The Measurement of Knowledge and Technology" Daniel Bell chooses indicators which describe components in a model of the post-industrial society. In the industrial society, development was determined by capital. The post-industrial society depends on "human capital" instead. Knowledge, defined as "a set of organized statements, setting forth a reasoned judgment or an experimental result, which is transmitted to others through some communication medium in some systematic form" (p.161) and derived from theory rather than simple empiricism has become essential to the organization of society. Therefore, individuals must extend their education in order to constitute the required intellectual personpower. Bell began the description of the dimensions of a "knowledge class" with indicators of skilled and scientific personnel, student population, degrees granted, and the distribution of scientific personnel by institution and discipline. He also considered input variables such as the concentration and allocation of resources in terms of institutional funding and student manpower for research and development.

Beverly Duncan contributed a chapter to the same volume entitled "Trends in Output and Distribution of Schooling." She presented statistical series on enrollment, type of school, and the per capita years and days per year of schooling. She advised compilation of data for a cohort (a group of people sharing a date of membership, e.g., in birth or schooling) as a means of clarifying interpretation of the measures. Thus, the measurement of educational outcomes taken for a group experiencing the school system simultaneously compared to the outcome for a group entering school at a later date indicates any changes resulting from exposure to the system. Historical threats to the validity of such conclusions are not controlled for.

In 1969, Russell Sage published a second volume in its series on social indicators. Compiled by Abbott Ferriss, INDICATORS OF TRENDS IN AMERICAN EDUCATION presented time-series measurements concerned with the educational system and achievement of educational goals. It was intended to provide the basis for monitoring education. Such "monitorship of the system" was seen to have three functions. First, it would present criterion indicators which were

intrinsically interesting (e.g., percentage of age group enrolled in school by decade).

Second, it would include indicators that could forecast a change in a second variable (e.g. decrease in elementary school enrollmen. indicates a predictable decrease in high school enrollment). And third, it would document changes that require explanation and further research. These were chosen if they measured a condition thought relevant to the system's effectiveness.

Ferriss employed six types of statistical series (1969, p.11):

1. A simple aggregate or frequency (e.g., total enrollment in elementary school);

2. Ratios and other quotients, expressing one aggregate in relation to another (e.g., expenditure of public elementary schools per student enrolled);

3. Percentages (e.g., percent male of all college faculty);

4. Rates, like percentages, expressing the number in one class divided by the total of all eligible (e.g., enrollment rate of a group);

5. Means, medians (e.g., mean score of group on aptitude test);

6. Contrived aggregates, based on the sum of a number of frequencies, each weighted with a different value (e.g., the Academic Production Index, a summation of the product of degrees and an appropriate value for each degree).

In TOWARD A SOCIAL REPORT (HEW, 1969), output indicators were recommended for the education sector. This was approached from two perspectives, that of the individual and that of the educational system. Output for the individual consisted of: 1) number of years of schooling, 2) degrees attained, and 3) social mobility.

Indicators of output regarded as products of the educational system included: 1) proportion of the population graduated from high school, 2) proportion of the population made literate, and 3) number of days of schooling provided per year. The data on learning achievement implicated factors other than the educational system (e.g., socioeconomic status) to account for the poor showing of American youth in comparison to the students of other nations. These data were interpreted not as indicators of the failure of the school system alone; rather, they revealed the lack of attention the educational system had devoted to research and development of methods for overcoming the barriers to learning imposed by other components of the social system.

The effort to present outcome statistics was furthered by HEW in INDICATORS OF EDUCATIONAL OUTCOME, FALL 1972. This document classified outputs into primary, secondary and tertiary effects. Under primary effects two main categories were dealt with: 1) product consumption which included quantity measures (e.g., high school completions), and quality outputs (e.g., achievements and attitudes), and 2) investment in human capital which was measured with income statistics (e.g., earnings or added earnings) and employment data (e.g., unemployment rates).

The lifetime consequences of education were presented as secondary effects. Included as investment feedback was economic growth reflected in lifetime earnings, lifetime schooling and median annual income. Consumption patterns were also considered evidence of second-order effects of education. The intergenerational impacts of education were included as tertiary effects.

Statistics presented in this document are explicitly related to a process model of the educational system. The limitations of such a compilation are two-fold. First, the lack of input data severely constrains the analysis possible. Only the hypothesis advanced by the editors (education influences variables A,B,C) may be exercised on this model. A more complete model would allow others to propose, test, and conceivably, validate, alternative hypotheses. Second, although this collection of statistics attempts to span the lifetime of the individual, it is based on a static model of the educational system. The purposeful neglect of time series renders the product useless for discussions of change and, once again, restrictive for the construction of theory.

A recent effort to construct indicators of the condition of the educational sector is found in SOCIAL INDICATORS 1973, issued by the Office of Management and Budget. Education indicators are included to describe one of eight major areas of social interest, the others being health, public safety, employment, income, housing, leisure and recreation, and population. Within each area indicators have been selected to "reveal the general status of the entire population; to depict conditions that are, or are likely to be, dealt with by national policies; and to encompass many of the important issues facing the Nation" (p.xiii). The emphasis is on time series at the national level. Indicators of objective variables were shown in graphic form and disaggregated by sex, age, race or income level for conditions expected to affect particular subpopulations. Educational attainment, achievement, and enrollment were measured, but no model of the educational system was developed. Subjective characteristics, such as attitudes, were neglected.

Discussion of this publication at the Review Symposium organized by the Social Science Research Council's Center for Coordination of Research on Social Indicators resulted in the following suggestions for additional measures (Van Dusen, 1974, p.6):

1. Estimates of returns to education;

2. Data on distribution of educational resources by geographic areas and populations;

3. Information on working conditions of teachers;

4. Statistics depicting growth or decline of the different kinds of organizations dispensing educational services;

5. Data on how people finance their education;

6. Measures of coverage and output of manpower training programs;

7. Cross-classifications of occupation by years of schooling;

8. Indexes of educational activities conducted outside the formal schooling system;

9. Projections of future school enrollment;

10. Information about special groups in the population, such as dropouts;

11. International comparisons of scholastic achievement adjusted to secure comparability.

Although this work was regarded as a considerable advance for the "social indicator movement," its inadequacies are reflected by this extensive list.

Indicators of a particular component of the social system, such as education, can also be used to compare the condition of that component across nations. A paper by Wolfgang Zapf in the report of the Review Symposium of SOCIAL INDICATORS, 1973, presents a comparison of social indicators reports from France, West Germany, and Britain. While each report offered a few innovative indicators, the statistics upon which comparisons could be based were few. In the educational sector, only measures of attainment, graduation and retention were offered by all reports. Japan published a WHITEPAPER ON NATIONAL LIFE, 1973 using a social indicator approach. Included under education were measures of higher education enrollment disaggregated by area, level, financial control, cost, and region. A few measures of faculty were also given.

As the social indicator approach becomes more common, it is expected that nations will work out more comparable systems for international evaluations. Different characteristics are desirable when education indicators are derived from a model of the social system than from a model of the education system. In the former, they are apt to be highly aggregated, quantitative, output measures. Within a subsystem, such as the educational system, indicators present more detail, are disaggregated in several ways, include input and analytic variables, and may be qualitative. Some of these differences are examined in the next section.

2.D. INDICATORS OF EDUCATIONAL KNOWLEDGE PRODUCTION AND UTILIZATION

Thus far we have considered the general social system and the narrower educational system. We will now consider the role of social indicators for educational research and development by reviewing the similarities and differences among the systems. The implications of these comparisons will be drawn for the educational research and development system.

In order to understand the social system, complexity of components, structure and processes must be reduced. Therefore, we force the components into a simplified macro-model which sacrifices detail in the interest of revealed pattern. Social indicators are located in this model at the points of input, critical interaction, or in position to measure outputs. The plethora of boundary crossings within the system among components, and between the system and exogenous variables, obscures our perception of the crucial interactions or linkages. This complexity has impeded the development of indicators for the social system. To avoid embroilment in a chicken-egg controversy (which comes first, the model or the indicators?), we have accepted a notion of incremental development in which a model is specified and the position of the indicators within the model contributes to the testing of their construct validity. If the indicators behave as predicted by the model, we accept that they are measuring what we have supposed. If not, we call into question the indicators' ability to measure the specified phenomena. An indicator that withstands further examination may challenge the validity of the model.

Dwarfed by the social system, the educational system and the system of research and development in education appear concentrated and more easily defined. We can limit their scope to the formal structures and expect to contain them. Because they were constructed for the most part purposefully, we expect to control them.

Systems, however, change form over time; as our understanding changes, so does the conceptual shape and practical organization of the system. Also, systems spread to fill the space available to them. The reintroduction of detail accounts for much of this expansion. Therefore, as we focus attention on these subsystems, the abundance of variables and complexity of interaction rival those aspects of the social system. Once again it is difficult to conceptually manage all of the possible measurements. The key difference between the component systems and the general social system is the amount of control and responsibility assumed by individuals for the systems. We know that policy can manipulate the system by the flow of funds and through the direction of regulation. What then are the roles that social indicators can play in monitoring the educational research and development system?

The primary goal must be reporting on the state of the system. Indicators sensitive to what comes into the system, to interaction within the system, as well as to output of the system provide a description of how the system currently operates. In Chapter 4 we present a model of the educational research and development system as it has evolved to the present. By reviewing past

models we recognize progressive shifts of emphasis. As we learn more, the model expands, feedback loops hitherto ignored call for measurement. Indicators provide description of a new conceptualization of the KPU system based on its observed performance. Aware that the concepts and patterns of interaction will continue to change as the system reforms, we have aimed to incorporate as many variables as possible. The model developed in Chapter 3 draws attention to possible indicators of output although the 1975 DATABOOK contains many more input indicators. This imbalance was necessitated by our reliance on existing data with no opportunity to create indicators which would round out a system description based on the model.

A few caveats are necessitated by the inclusion of these variables. When inputs and outputs are presented with a nebulous process intervening, our natural tendency is to draw causal inferences. These are not yet justified for several reasons. First, it is likely that we have omitted outputs of the system due to lack of understanding or lack of measurement. New indicators of productivity are being explored. The products of development are phase outcomes but not final outcomes if we insist upon knowledge utilization. To conclude that products reported on are the sole result of R&D expenditure is misleading. To assume that there is an immediate and direct response in the educational system is equally faulty. Particularly, as we seek the consequences of research activity (as differentiated from development), we expect long-term delays. Ramifications of today's work may not be obvious in the school system for many years. Indicators of input and output maintained consistently might eventually reveal patterns of time intervals necessary to see such effects.

It should be equally clear that we are unable to include all factors relevant to education. Certain nonmanipulable variables encountered in educational practice, such as home environment or innate ability, may dominate the educational outcomes. Research cannot hope to counteract all these variables, and yet it frequently is held accountable for student achievement. These variables will not be included as indicators of the research process although they may be involved in the substance of research.

In favor of description, we have minimized the normative dimension possible for indicators. Norms are largely relegated to output indicators and we have argued for the inclusion of input and analytic variables. In addition, the imposition of norms for the R&D system seems premature. Norms generally follow a particular paradigm and a specific set of values whereas the progress of science may be marked by a change in paradigm (Kuhn, 1962).

Land (1975) suggests that normative indicators allow one to convert a social indicator model into a social policy model. He proposes that a social indicator model analyzed to determine whether a desired social state is feasible will indicate also which policy transformations may be undertaken to accomplish it.

Policy setting remains a potential goal for indicators of educational research and development. The specification of norms, however, is apt to limit generation of theories which could test the system's componential interrelations. The simple model in which our indicators are based can adapt to

encompass many theories. The exercise of theories can be facilitated through inclusion of input and process indicators rather than prescribed norms. Perhaps, in the future, norms can be established for individual indicators, such as methodology of research. Thus, the percent of research conducted with well respected methods might be an output indicator for research, or an input indicator for the utilization of knowledge.

The temporary lack of norms on which to base indicators does not prevent policy formulation. The educational research and development system is an artificial structure. Unlike the social system, which exists regardless of form or controls, the R&D system was deliberately created (albeit piecemeal) and must be maintained with policy decisions. Inputs to the system are, for the most part, quite manipulable. Performance of the obligatory control responsibility can be improved with information from indicators on the points of intervention. This information combined with the values and standards of policy makers will substitute for indicators with norms worked in, suggesting future policy directions.

2.E. CONCLUSION

The "social indicator" approach promises to provide a mechanism for monitoring and reporting on the condition of educational knowledge production and utilization. Time series statistics which are intrinsically interesting or are derived from their location in a model of the system can describe the system in terms of inputs, process and outputs. Inclusion of input and process indicators allows for the development of alternative explanations for output phenomena. Normative output indicators are most conducive to policy formulation, but the values underlying such indicators need to be recognized.

In Chapter 3 we present several process models that have been employed to describe educational R&D or the broader RDD&E systems. The model from which we derive "ideal" indicators extends this thinking to knowledge production and utilization with an emphasis on balancing or equilibrating the system.

3. MODELS OF KNOWLEDGE PRODUCTION AND UTILIZATION

3.A. DISTINGUISHING MODELS FROM THEORIES

Much controversy revolves around the definitions, functions, and criteria of "models." We seek to avoid this controversy by presenting a conceptualization of "model" on which we base our understanding of knowledge production and utilization. Our conceptualization is based to some extent on Leonard Hawes' synthesis (1975) of positions on the philosophy of social science expressed by Abraham Kaplan (1964), May Brodbeck (1968), and Robert Dubin (1969), and others.

Most simply, a model can be thought of as an analogy. It provides an analogue, along one or more dimensions, for a second process or object. Due to the multifaceted nature of all phenomena, only partial isomorphism is expected in the analogy. In other words, some dimensions of the model will fail to describe the phenomenon being studied. However, the salient structural and/or functional features of a successful model can be employed to organize information about the nature, state, operation or purpose of the modelled phenomenon. This is accomplished by mapping the substance of the phenomenon onto the logical or physical structure of the model.

The structure of the model is generally derived from a fairly well-developed theory accepted in another discipline. The structure is abstracted from the entire theory without substance. The substance is then supplied by the object or process being studied. The result is a description of the phenomenon in which complexity is reduced sufficiently to permit emergence of pattern, order, derivation, and deduction.

One has latitude in choosing which aspect of phenomena the model will focus upon. Structural description, as discussed above, is perhaps the most common. Description of the function or process can also be incorporated into a simulation model -- that is, a dynamic semblance of the variables operating in relation to one another.

Models may also be employed to explicate concepts. Through graphic depiction or mathematical description, concepts later to be used in theory construction may be clarified.

A model, however, does not purport to explain the substantive process or object. It depicts or represents; explanation is the essence of theory.

This distinction between models and theories is not always clearly articulated. The overuse of both terms in current social science results in a proliferation of "models" or "theories" which do little to reduce the complexity

of issues confronting us. Kaplan (1964, p. 263) suggests that only formal or postulational theories are adoptable as models. As "scientific metaphors," models are capable of condensing significant similarities. While stressing that it is the pattern or order of a system which allows it to act as a model, rather than the content, he does not differentiate on the basis of explanation. Instead, he proposes that a model abstracts data "to the point of treating as relevant only two structural properties" while a theory does not necessarily "exhibit that structure in itself" (p.265). He justifies usage of "model" in the following five senses (pp.267-268):

1. Any theory more strictly formulated than is characteristic of the literary, academic, or eristic cognitive styles, one presented with some degree of mathematical exactness and logical rigor;

2. A semantic model, presenting a conceptual analogue to some subject matter;

3. A physical model, a nonlinguistic system analogous to some other being studied;

4. A formal model, a model of a theory which presents the latter purely as a structure of uninterpreted symbols;

5. An interpretive model, providing an interpretation for a formal theory.

Kaplan accepts that models, by making structure explicit, conscious, and definite, prevent a false sense of pursuing an "idea." He insists that theories, on the other hand, are played within a vague and malleable form. Thus, by contrast, models safely insure that the scientist's intent is made clear. Hawes, by contrast, bases the distinction on the explanatory nature of theories. A theory explains as it "accounts for the causal or correlative relations among its component concepts" (Hawes, 1975, p.111).

In modeling educational research and development structures and processes, we follow the direction of Hawes. As yet we have no theory capable of explaining either structure or process. Our hope is to provide description rich enough to generate microtheories capable of relating structures and processes within the R&D system. Known complexity forbids contemplation of a unified theory from which predictions may be derived for the entire system. The existence of a descriptive, semantic conceptual model, however, affords an overview which facilitates "monitorship" of the system. Physical or scalar models which represent the object while maintaining relative proportion and critical features are inappropriate here. The necessary physcial identification, as in a model airplane, cannot be duplicated for process other than through simulation. The rigor of mathematical or formal models currently appears as the objective of most social science research. While progress in applying these models has been made in disciplines such as sociology, psychology, and

economics, educational research lags behind. The relatively new and person-made nature of the educational KPU system is at least partially responsible for this. The system is continually being formed and reformed, its structures and functions hardly remain stable long enough to support assumptions. We rest, therefore, with a conceptual descriptive model.

Hawes suggests three criteria for evaluating models:

1. The structure-providing theory must be developed sufficiently to provide new insight into the process or object being modeled. The model must have heuristic value.

2. At least partial isomorphism of structure or function between the model and the phenomenon under consideration is necessary.

3. There must be specification of the rules of correspndence between the structure and its mapped material so that others may determine the adequacy of the model as well as interpret it.

Once having met these criteria, models perform several functions. The specification of structure facilitates communication between scientists. Concepts and relations presented in loose literary form are open to multiple interpreations by the reader. Explicit models limit this uncertainty. They tend to clarify, simplify, and organize the presentation. In addition, models prioritize considerations by focusing upon certain concepts or processes to the neglect of others. An organizing structure eliminates detail, revealing pattern. In a synthetic system, such as KPU, the logical completion of a model can indicate alterations to be made. Perhaps most important, rigorous models lead to prediction. They provide the framework from which logical hypotheses may be drawn, and upon which theory may be exercised and tested. As our social science sophistication increases, we move further from the expectation of finding any one theory to demystify our experience. Instead, we propose models from particular perspectives and derive what utility is possible for the perspective held. "Theoretics" or "miniature systems" propose to reduce equivocality in limited spheres. Occasionally, relating previously unrelated phenomena allows an intersection of domains which expands the scope of our surveillance. When this occurs, old models are supplanted by new constructions more broadly based.

The sequence of models for educational research and development has followed this pattern. In the following sections we will briefly retrace this progression as it evolved in two dimensions for knowledge production and utilization. First, we will examine the general Federal regulations which continue to shape the KPU system. Second, we will recount the development of conceptual models offered to describe this sector. In the last part of this chapter we present a current extension of these models and the implications for indicators derived from it.

3.B. FEDERAL INFLUENCE ON EDUCATIONAL KNOWLEDGE PRODUCTION AND UTILIZATION

Although the Federal government is not the sole source of educational research and development support, it has played a major role in shaping the KPU system over the past twenty years. The effects of this influence will not be discussed here, but the need for this influence can be explained.

America's attachment to capitalism and "free enterprise" conditions us to look warily at products or services unable to survive on their own. We assume high demand for meritorious products, the profit from which will inspire increased supply. In this economic view, if educational research and development is not supported by an interplay between private industry and the marketplace, we assume it must in some way be inferior.

The problem, however, does not lie in the quality of the product but in the essence of the product, i.e., in the nature of "information." The distinguishing characteristics of information as a product of research are such as to discourage investment by the private sector in such activity. The reasons for this underinvestment are succinctly expressed by Kenneth Arrow (1971, p.152):

> "To sum up, we expect a free enterprise economy to underinvest in invention and research (as compared with an ideal) because it is risky, because the product can be appropriated only to a limited extent, and because of increasing returns in use. This underinvestment will be greater for more basic research. Further, to the extent that a firm succeeds in engrossing the economic value of its inventive activity, there will be an under-utilization of that information as compared with an ideal allocation."

These problems do not disappear even when support is given by the Federal government. The risk of investing in research and development is a consequence of uncertainty concerning the end product. In most production we can determine the range of outputs by knowing what inputs and operating conditions are involved. For markets in which this is not possible, mechanisms such as insurance and "future" markets attempt to decrease risk. The limitations of these techniques result in underinvestment.

In research and development activities, the value of the product is not known until it is produced. No standards for determination of cost or worth before production exist. Thus, investors in educational research and development risk spending sums of money at the outset for doubtful returns. A second problem in the nature of information rests in the low cost of duplication. Once information is produced, it is hard to contain. Often, the use of information decreases its market value. Private industry will not invest in a product which becomes freely available upon production. Information that quickly becomes a public good will only be supported by the public sector.

Unfortunately, the public sector is frequently expected to perform as efficiently as private industry. Thus, though willing to support a minimum level of R&D activity, the Federal government is expected more and more to have products to show for it, i.e., to manage a high risk situation with a high success rate.

The fact that value derived from knowledge production activities is difficult to appropriate represents another problem for the accountability of the Federal KPU system. Although a large part of the R&D effort is supported by the government, any of that knowledge can be used by others in the private sector to apply to profit-making ventures. As Arrow points out, the more firms that capture this information, the less accessible it is to the public.

Due to the complicated nature of "information" and "knowledge" the task of constructing an educational R&D system has fallen to the Federal government. We find, as we sketch the history of Federal acceptance of this role, a gradually evolving system for the knowledge production and utilization sector. The shape of this system, rather than the history and analysis of regulatory policy, is most relevant to this report. A more detailed account of Federal regulation is presented in the 1975 DATABOOK.

Prior to 1954, the major Federal experience in "procuring" research and development lay in the military sector during and after the war. The utilization of products and knowledge resulting from military R&D could be mandated without particular concern for the sociopsychological factors that facilitate or inhibit change in a less hierarchical social system. Information and products flowed in one direction from the military researcher/developer to military users. Inapplicability of the military R&D experience to domestic (e.g., education, health) programs was a gradual discovery of the 1950's and 1960's.

The Cooperative Research Act of 1954 provided the first major legislated authorization for educational research. Funds were made available to "universities, colleges, other public and private agencies, institutions, organizations and to individuals... for research, surveys, and demonstrations in the field of education..., and for dissemination of information derived from educational research."

This act adhered to a pluralistic, competitive model of research. Research was looked upon as a joint effort in which the sponsoring agency served as benefactor to the respected researcher. Funds were generally granted on the basis of the researcher's reputation with little expectation or demand for specific products. Although, within the Act, concern was expressed about questions of educational finance, division of responsibility between local, State, and Federal agencies, as well as equalizing per pupil expenditures among States for elementary and secondary education, researchers were not restrained in their pursuit of knowledge.

As Guba and Clark point out (1975), this approach was too dependent upon the individual perspective of particular researchers with no attempt to cumulate

results and little attention for the other processes of the KPU system, i.e., development, diffusion, and utilization.

In 1958 the force of these objections was mitigated with the passage of NDEA. The National Defense Education Act and its numerous titles provided for categorical research. This was a strong step in designing the shape as well as the substance of educational research. In addition, attention was paid to other aspects of the KPU process. For example, Title VII of NDEA provided for "research and experimentation in more effective utilization of television, radio, motion pictures, and related media for educational purposes, as well as the dissemination of such knowledge and products once gained."

This step also served to lower, if only slightly, the risk attached to such investment. Under this form of funding, the Federal government eliminated some uncertainty by specifying the areas of inquiry and possible products. Probable utilization or marketplace acceptance could enter into the specification.

This program, however, still delineated a linear path for the R&D process. Information and products were to flow from the sponsors (in the form of funds and directives) to the researchers, and through dissemination, to the practitioners.

Although informal assessment of the success of programs and projects played some role in determining future funding, not until Title III of the Elementary and Secondary Education Act of 1965 was there a legislated requirement for evaluation. For the first time, there was an attempt (albeit without much success) to evaluate innovative programs. Information derived from the evaluations was meant to feed back into funding decisions.

The actual wording of the bill did little to assist program managers with the design of evaluations and, for the most part, the evaluative tasks were poorly done. The significance of mandated accountability, however, is greater than its early implementations. The output of educational R&D could now be followed beyond dissemination and utilization to its effects. Measurement of these effects, crude though it was at first, then was fed back to the point of origin, i.e., to the funding and directing Federal agency. Thus the first loop of a recursive KPU model was structured by this regulation.

Additional legislation continued to flesh out various components of the system. The 1965 Amendment to the Cooperative Research Act provided for the construction of regional facilities for research and related activities. The educational R&D Labs, similarly, were created to improve the development and dissemination components of the system.

The role of evaluation has increased in the past five years. Large-scale studies of such programs as Headstart and Follow Through indicate the appetite of decision-makers for this form of information about researched programs implemented in the field.

The development of Federally legislated KPU from, initially, "multiple, individualistic shots in the dark" through a linear process and now to a recursive, system-oriented structure has been a progressive, if sometimes vague,

pattern. Conceptual modelling of this process occasionally preceded, more often followed or was concurrent with the shaping of the system by funding policies, legislation, or the interests of researchers. In the following section, we sketch in the KPU model as it has been described by researchers, administrators, and policy makers.

3.C. CONCEPTUAL MODELS OF EDUCATIONAL KPU

Conceptual models of educational R&D or KPU have generally focused on particular components within the system rather than comprehensive reporting. Some exceptions, such as the documents of NCERD (e.g., EDUCATIONAL RESEARCH AND DEVELOPMENT IN THE U.S., 1970) and occasional suggestive papers (e.g., Gideonse, 1968), exist. For the most part, however, models have been created to depict one subsystem and what we now consider the "KPU system" served merely as a blurred background for this detailed component magnification. The resultant biases of these models become obvious as we seek a balanced overview of the system.

In 1966 Sam Sieber, with the collaboration of Paul Lazarsfeld, produced a research report on THE ORGANIZATION OF EDUCATIONAL RESEARCH IN THE UNITED STATES. The subject of this document is "research." In isolating this component from what we now understand as a larger system (KPU), Sieber and Lazarsfeld were satisfied with a static conceptualization. The target of their inquiry was modelled as object rather than process. The objectified "research" was presented as a passive phenomenon with multiple variables impinging upon it. Research was conducted within large-scale social organizations whose features were suspected to influence the sentiments and activities of research participants. Therefore, measures were obtained on a large variety of "formal organization features" such as "size and selectivity of the student body, administrative arrangements for the facilitation of research, financial resources and their allocation."

Demography of the researchers, their activities, and their attitudes were also considered relevant to the production of research. Finally, Sieber and Lazarsfeld were interested in institutional outcomes, such as research quantity, research quality, and the number of graduates who enter research positions. These were not seen as products of "research" but rather factors affecting the current status of educational research viewed as an entity. Also determinant were the historical development of research organizations and the social context of education. Figure 3.C.1 presents the implicit model of research upon which this study was based.

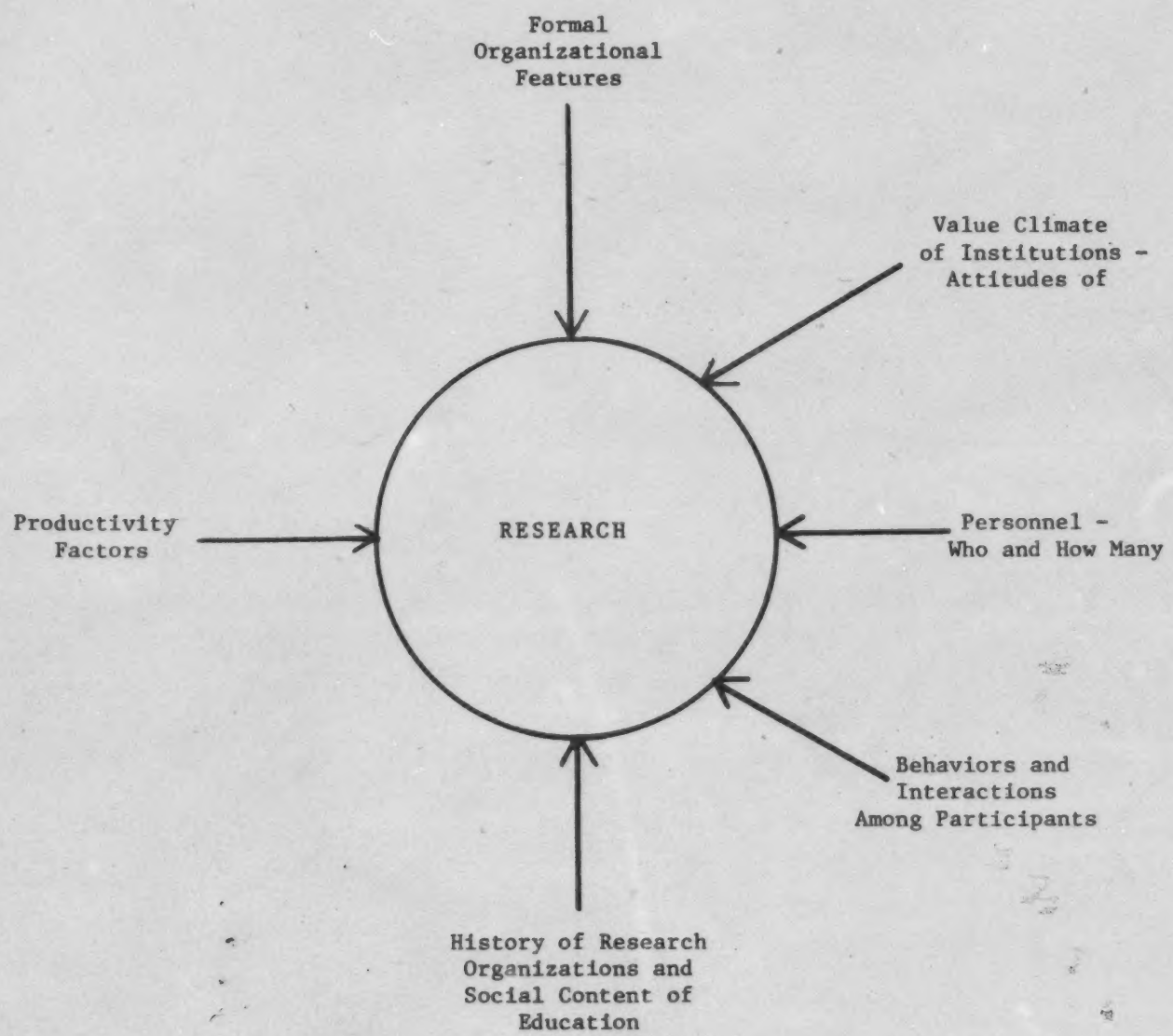
(INSERT FIGURE 3.C.1 ABOUT HERE)

This relatively simple view was in keeping with Federal policy on educational research prior to the time of the study but seems to lag behind NDEA in attention to dissemination.

In the interest of overcoming some of the obstacles which prevent translation of theory into practice, Guba and Clark (1965, 1966) developed a four stage, mostly linear, model of the KPU sector. Guba described these stages in a paper presented in 1967 at the UCEA Career Development Seminar (pp.42-43). The first phase is research, which has as its basic objective the advancement of

MODEL OF EDUCATIONAL RESEARCH BASED ON

THE ORGANIZATION OF EDUCATIONAL RESEARCH IN THE UNITED STATES, by Sam Sieber and Paul Lazarsfeld, 1966.


Formal Organizational Features
Value Climate of Institutions - Attitudes of
Productivity Factors
RESEARCH
Personnel - Who and How Many
Behaviors and Interactions Among Participants
History of Research Organizations and Social Content of Education

knowledge. Research provides one input for the next phase, development. The basic objective of development is the "identification of operating problems and the formulation of solutions to those problems." The solutions are to be workable in the real world.

The third phase of this process model is diffusion. According to Guba, diffusion "has as its basic objective the creation of awareness about new developments and the provision of opportunities for their assessment along whatever dimensions practitioners may deem necessary." In the last stage of this process, which Guba calls "adoption", the development must be adapted to the local situation and installed. Implied at this stage is some form of demonstration of the development within the operating context.

The activities required within each phase are portrayed in Figure 3.C.2.

(INSERT FIGURE 3.C.2 ABOUT HERE)

Different types of evaluation are considered relevant in each stage of the process. We have included them within the appropriate phases although Guba pulls them out for deeper analysis. The evaluation types are borrowed from Stufflebeam (1967). At each point evaluation is seen as the circulation of information within a particular phase rather than feedback to a prior stage in the process. While Guba and Clark admit discrepancy with empirical research, the model is offered as a logical construction designed to draw attention to some of the gaps in the educational KPU system as it existed.

A model for the KPU sector was offered by Ronald Havelock in 1968 which employs a slightly different terminology derived from its emphasis on personnel. This model began to account for the bidirectional interaction between participants, growing beyond the preceding linear models. Havelock was concerned, as were Guba and Clark, with the process through which produced knowledge would be utilized. He emphasized a "linkage" component between the researchers and the practicioners as depicted in Figure 3.C.3.

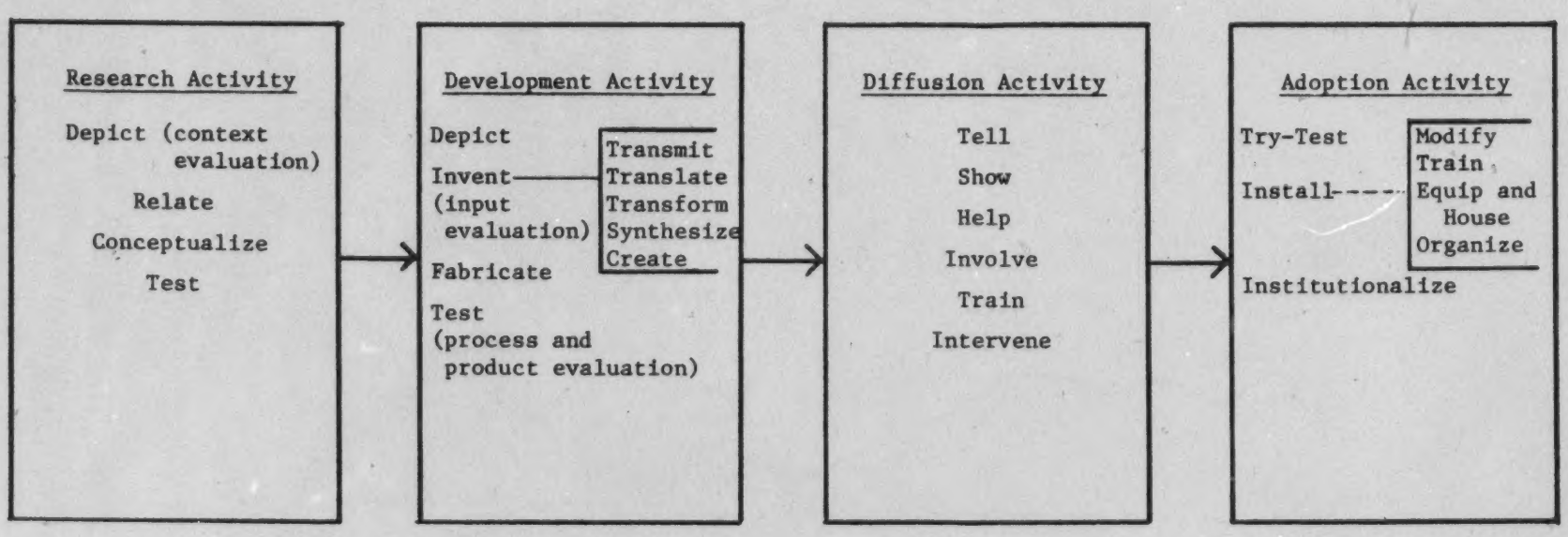
(INSERT FIGURE 3.C.3 ABOUT HERE)

The distinction between researcher and developer is articulated in other terms. Within a research and development component, which Havelock refers to as the "resource system", he places scholars and basic researchers, applied research and development personnel, producers, and packagers. These individuals then pass information and products out to the main linkage personnel, consultants, conveyors and trainers. Links are then established with a "client system" or the institutions of the operating school system. Recipients in this component are leaders, innovators, defenders and finally users. These relationships are depicted in Figure 3.C.4.

TECHNICAL REPORT FIGURE 3.C.2

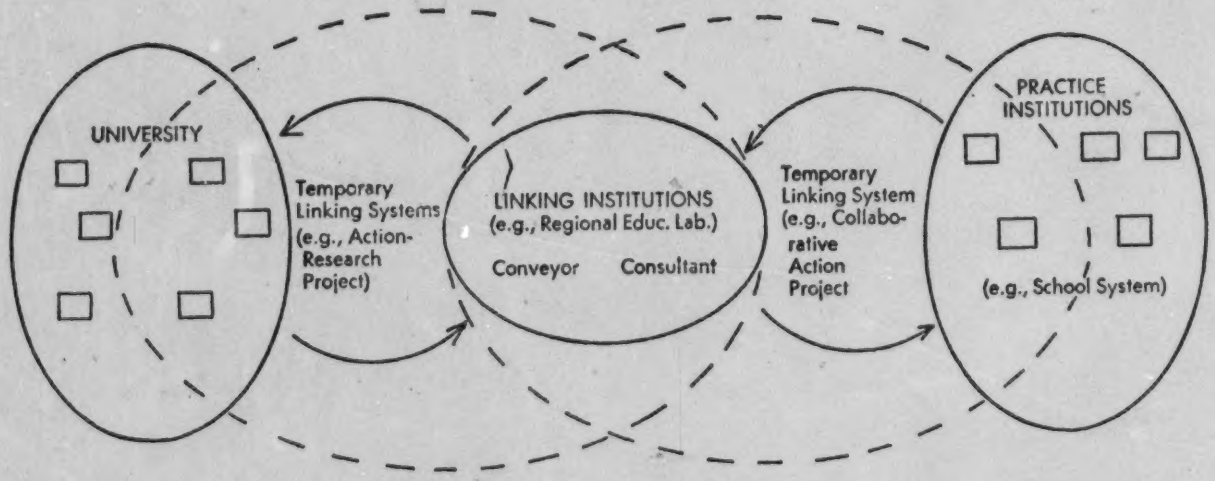
MODEL OF KNOWLEDGE PRODUCTION AND UTILIZATION BASED ON WORK OF EGON GUBA AND DAVID CLARK

(As Presented by Egon Guba in "Knowledge, Production and Utilization," 1968.)



TECHNICAL REPORT FIGURE 3.C.3

LINKING INSTITUTIONS: SEPARATENESS AND TOGETHERNESS



Solid lines represent **permanent** systems
Dotted lines represent **temporary** systems

From Havelock, Ronald, 1968 p. 107.

(INSERT FIGURE 3.C.4 ABOUT HERE)

Hence, Havelock perceived all participants as "links" in some capacity as they play their roles in the KPU process.

In 1970 the National Center for Educational Research and Development released a major document on the condition of educational research and development. The book, EDUCATIONAL RESEARCH AND DEVELOPMENT IN THE U.S., was compiled under the direction of Hendrik Gideonse. Based on a KPU model which consisted of research, development and dissemination, this volume draws together the relevant statistical information and narrative to describe the sector in a manner conducive to decision-making. In an earlier paper, Gideonse (1968) developed the structure of this model. His focus is upon the "outputs" of both research and development which can be passed along to other activities. The products of research are transferred to development. Development outputs are offered to the educational system. Gideonse develops the scheme as a process which can originate at any point. Thus, he moves even further from the linear model to one in which knowledge production can be initiated by researchers, developers or practicioners. In addition, he acknowledges the need for information flow, in all directions, among these components. Figure 3.C.5 is taken from Gideonse (1968, p.542) and illustrates his conceptualization of the process.

(INSERT FIGURE 3.C.5 ABOUT HERE)

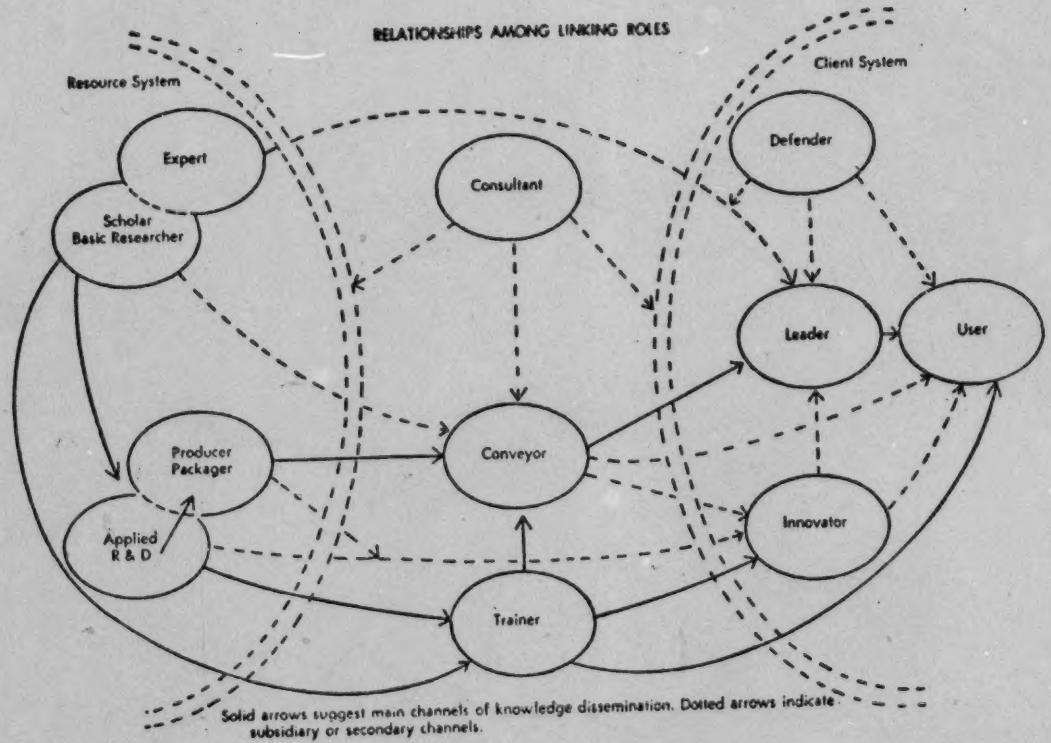
Depicted are the initiatives (o) of activity, the outputs (Δ) of activity, and the direction (→) of activity. The objective of this conceptualization is increased utility for the decision maker.

Implicit in this model and explicit in Gideonse's writing is the need for feedback based on performance. He also presents a scenario in which the administrator or practitioner within the formal school system "exercise(s) his prerogative and call(s) for the initiation of a project to design and develop a process whose performance specifications are such that it will yield in his school the desired educational output" (p.542). While this is an extension of the scheme with which we sympathise (and will return to later), as yet there are few mechanisms for its fulfillment in reality.

Stacy Churchill (1974) has recently developed a more sophisticated conceptual framework for educational R&D. His attempt to encompass the whole KPU sector borrows its structure from systems theory. This work approximates a balanced perspective with an equalization of emphases among components.

(INSERT FIGURE 3.C.6 ABOUT HERE)

TECHNICAL REPORT FIGURE 3.C.4

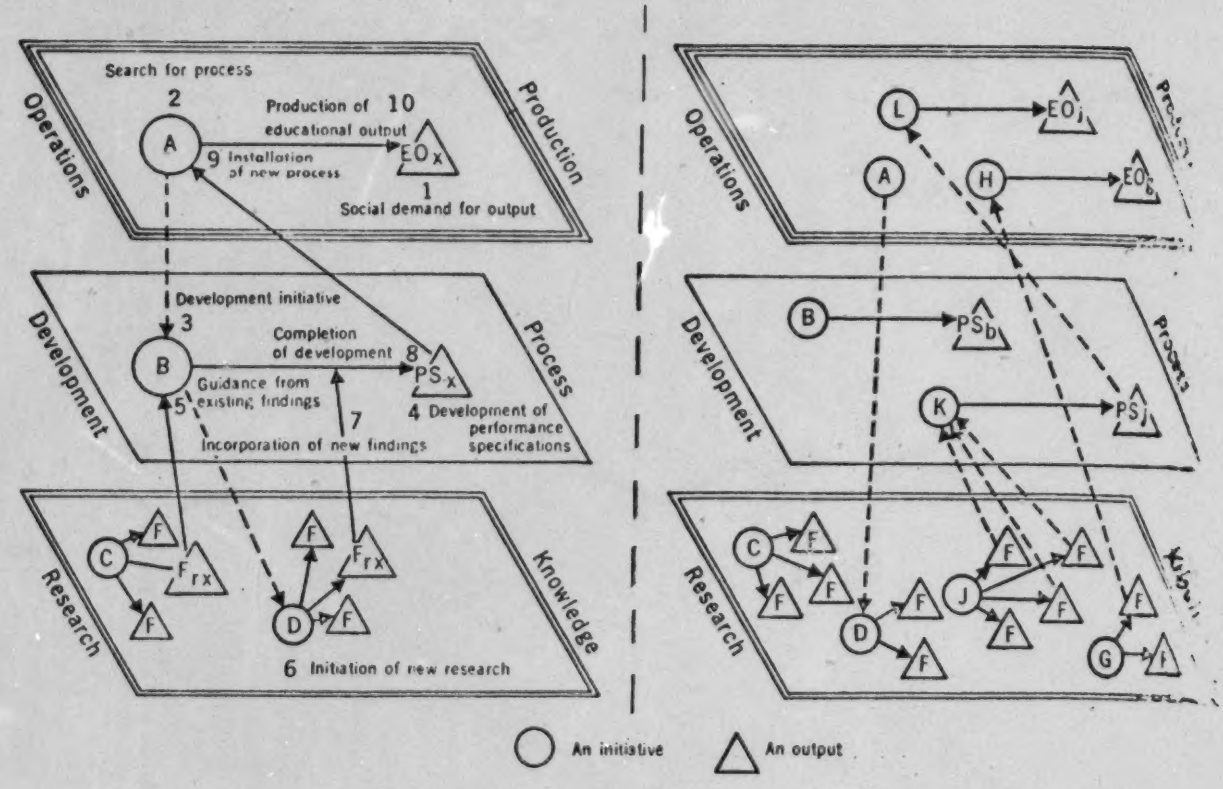


From Havelock, Ronald, 1968 p.91.

TECHNICAL REPORT FIGURE 3.C.5 (a) and (b)

(a) (left). A "WALK-THROUGH" OF THE OUTPUT MODEL OF EDUCATIONAL RESEARCH AND DEVELOPMENT

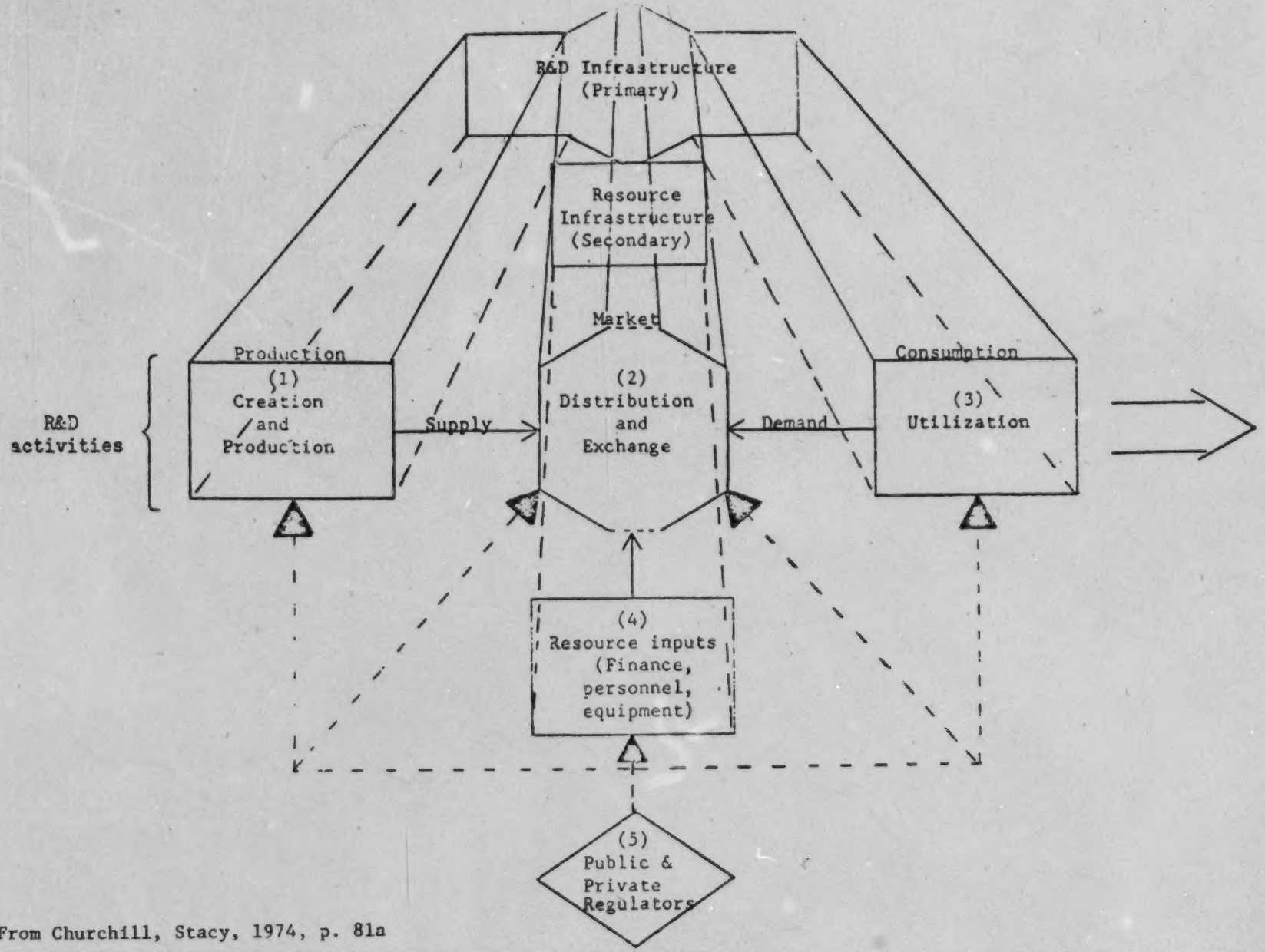
(b) (right). SAMPLING OF THE POSSIBLE INTERACTIONS IN THE OUTPUT MODEL



From Gideonse, Hendrik, 1968, p. 542.

TECHNICAL REPORT FIGURE 3.C.6

A REPORTING MODEL FOR EDUCATIONAL R&D



From Churchill, Stacy, 1974, p. 81a

The reporting framework rests on the following assumptions:

1. The system boundaries are defined upon specification of a set of users or potential users of R&D output;

2. Distinction between producer, process and product;

3. Inclusion of resource flows (funding);

4. Regulators (written and unwritten rules) are separated out.

Churchill has designated a "primary R&D infrastructure" component which includes the skilled personnel and equipment facilities within institutional settings. The "secondary infrastructure" provides the input flows of personnel and equipment for the primary infrastructure (e.g., through personnel training programs).

Churchill integrates these structures into the reporting framework with reference to an economic model. All factors interact in the marketplace, activated by the supply and demand relationship. The recursive nature of this model depends upon the information assumptions implied in markets. If we assume that suppliers have information concerning demand for particular products at different price levels, we expect a correlated modification of production behavior. To optimize trade, producers of R&D are reponsive to the demand of consumers (i.e., utilizers, practitioners in the school system). This "demand" information should feed back to the producer who can then adjust what is produced.

Inventive activity, as discussed above, is risky in that one cannot guarantee that useful output will always be generated. As private investment is inhibited by risk factors, and responsibility for investment reverts to the public system, practitioner demand is less critical in determining production. Support for research must be garnered from the government; research proposals must be primarily attractive to funding agencies rather than product utilizers. Although funding agencies seriously attempt to support research and development conducive to improvement of the educational system, their source of information concerning practitioner demand is often researchers (with whom they trade) rather than utilizers.

Another shortcoming of a market model is the resulting expectation for immediate "products." Exchange can only take place if both parties have something to trade. Inventive activity often requires large expenditures of time and money before there is any payoff. If "products" are required to justify cost, as in normal markets, numerous products will be developed, often at the expense of truly inventive activity.

Churchill's model, even more than that of Gideonse, attends to the role of policy-makers in determining the direction of the educational research and

development process. This direction is represented by the "regulators" indicated at various points in the model. Depicted in this way, however, interaction with and feedback to policy-makers appears unrealistically limited.

We have traced the gradual evolution of the educational R&D model from the objectification of research (Sieber and Lazarsfeld, 1966) through increasingly refined and differentiated linear models to a unified overview of the KPU sector. In the following section we further develop notions of a system of knowledge production and utilization which can guide the selection and development of indicators.

3.D. REQUIRMENTS OF A MODEL OF EDUCATIONAL KPU

Conceptual work underlying the DATABOOK drew heavily on Churchill's contribution. We have attempted to translate his "reporting framework" into a model based on systems theory. Churchill avoids the term "model" to emphasize that his framework is broad enough to accomodate several models of the KPU process (p.79). We have employed the term in its generally accepted usages (see section 3.A), believing that the comprehensive nature of the model presented indicates a further development of thinking in these areas. Proposing one model does not limit our ability to test numerous hypotheses or "theoretics." The social indicator approach nested within this structure would provide the data on which these theoretical premises may be tested.

We use the terminology of "systems theory" somewhat lightly in regard to the KPU sector. In no way do we expect to derive among the components formal relations which are quantitative or predictive. Instead, we acknowledge severe limitations in the degree of isomorphism possible between the functions implicated by general systems theory and the incrementally and deliberately developed educational KPU system. There are certain implications of the model, however, which point to the inadequacy of prior conceptualizations. Due to the fact that the KPU system is constructed rather than of natural organic evolution, the discrepancies between it and the system model can indicate a need to change, a positive direction for the modification of the KPU system. Thus the model may be used prescriptively as well as in partial description of what currently exists.

Common usage of the term "system" requires an explication of meaning we invest in it. We begin simply by distinguishing a system from an agglomeration of entities. The system is distinguished by the interaction of its components represented by flows of resources and information. Communication, or the flow of information between components, unifies the system -- that is, provides functional coherence. It is the flow of resources and information among components, more so than the historically idiosyncratic structure and process of each component, that our model of the KPU system emphasizes. resources and information, with which the KPU process can identify.

Preceding models have been distinguishable by the magnification of particular components of the system. Sieber and Lazarsfeld looked at research; Guba and Clark were concerned with the processes bringing congruency to knowledge production and utilization. Havelock and Gideonse focused on linkage,

marketing, and various utilization factors. In each case the emphasis biased the structure of the model in some direction. Churchill's view, while imposing balance, focused on market transactions slighting several elements of political and system-structure reality.

Our model differs from Churchill's framework in the elements and flows attended to, although "system" terminology is shared. We have emphasized the interface between components which generally is manifest in "flows." These flows consist of either funds or information. In addition to these linking channels, we have been concerned with the intracomponent relations when these can be differentiated. As investigation continues, we expect that progressively finer distinctions will be possible within subsystems. As the utility of such distinctions becomes clear, indicators can be added to the system report.

We may also find that processes we currently label "flows" become institutionalized as "components." The terminology is somewhat arbitrary, depending more on investment of funds than on conceptualization. As institutions are established to expedite or regulate flows, the significance of such processes appears to increase. The variables and their interaction within the newly established component call for measurement. Which indicators prove to be useful will be determined by the purposes they are meant to serve. Admittedly, these purposes will vary in accord with the orientation of researchers, practitioners and policy-makers attempting to read and interpret the system report. In all probability, even the "health" of the system will be understood differently by these different agents. For practicioners, an R&D system which responds speedily to the call for specific innovations may be ideal; for the researcher, freedom to pursue individual interests with generous support may constitute a healthy system; for the policy-maker, a system which adapts to solve new problems and discontinues itself after successful production may be the goal. A model for monitoring the educational KPU system should be hospitable to many relevant variables and capable of withstanding many such examinations.

Indicators should also relate KPU to the larger social system. This interaction with the social system occurs along several dimensions. The political system influences educational KPU through regulation and funding controls. As pointed out earlier, the Federal government is forced to assume a major responsibility for the system support. Prior models have de-emphasized the role of policy-makers in the KPU system. Although Gideonse (1968) orients his model toward the concerns of decision-makers, they are not explicit within it. Churchill (1974) does include regulators and funds, the products of policy-makers, in his framework for reporting on educational R&D (see Figure 3.C.6), but the mechanism for these inputs is not specified. Whereas a procedure is implicated for production and consumption of R&D (i.e., the supply and demand interaction of the marketplace), no active process is suggested for policy determination. Interaction with the school system, or what is usually called utilization, represents a second interface with the larger social system. This aspect of the process has been depicted in increasing detail, over the past decade. As the ultimate objective of most educational R&D is impact on the educational sector, a flow of products and information from R&D agents to practitioners or utilizers has been expected. In fact, a low level of product

flow and implementation in the formal school system has been interpreted as one symptom of poor health for educational KPU.

Interaction with the operating system, however, has largely been one-way communication. Products and information flow into this sector, but only students flow out. This poses a problem when attempting to orient research toward utilization. With no feedback, no sense of demand is attained by the researchers. As we suggested above, the school system is in a position to buy finished products only. Because the school system does not invest in research, the role of setting missions for R&D has fallen to the sponsoring agencies (generally the Federal government and foundations).

The model we have developed sketches in a complete educational KPU system. We began by examining the system as it currently exists. Next, we retraced its development, out of which emerged trends such as the gradual expansion, acknowledgement and inclusion of various components of the KPU system, the increase in Federal direction through mission oriented funding and legislation, and new feedback mechanisms among components and between the educational KPU system and the elements of the larger social system.

The confluence of these factors, along with the conceptual contributions of others, has structured an educational KPU system model from which we can derive indicators.

3.E A MODEL OF EDUCATIONAL KPU FOR THE NIE "DATABOOK"

Elaboration of KPU processes and consideration of interaction among processes has led us to a "system" model. In a recent article, Guba and Clark (1975) dispute the notion of a "system" for the KPU sector. They suggest that many of the disappointments and failures of KPU can be traced back to a "system" image. Unachievable aspirations, neglect of individual goals, overcentralization and persistent alteration of policy and programs, they feel, are the consequences of this conceptualization. The criteria they set for a new model are (p.6):

1. Completeness -- sufficient to account for the full spectrum of KPU functions;

2. Balance -- responsive to both individual and institutional goals of the wide range of agents and agencies involved in educational KPU;

3. Realistic -- reflecting with fidelity the real world of educational KPU.

The fact that the educational KPU sector does not perform in concert as a system is taken as evidence that the "system" model is inappropriate. Guba and Clark propose an alternative, the "configurational perspective," in which elements interact as a community. The components are specifiable and relevant to one another but do not form a unified system.

Although we are in complete agreement with the first two criteria offered by Guba and Clark, the third may be argued against in two respects. First, no model can "reflect with fidelity" all aspects of the phenomenon being represented. The isomorphism is necessarily slighted along some dimensions. Complete identification removes the representation from the "model" status. Which structural, functional, or procedural dimensions are adhered to is dependent upon the model and the purpose of the analoguing.

The second objection to a demand for realism rests on the alternative requirement for heuristic value. If a model strays from the nature of the phenomenon in some dimension but in so doing indicates a preferable form for the phenomenon, and if the phenomenon is person-made and alterable, then such divergence is justified.

By invoking a "system" model for educational KPU we reveal certain shortcomings of the system as it is currently structured. Those aspects contributing to discrepancies between the model and the KPU system may be responsible for the failures of the system as it operates. Because the educational KPU system can be modified, the model which differs in critical ways from the phenomenon has double utility. It is capable of describing the system and may also prescribe alterations which will facilitate operation of the system.

In Figure 3.E.1 we illustrate a system model of educational KPU which includes the major components of the system as well as the channels through which information and funds flow to make the system function. The system is not rigid and can adapt as new elements are seen to play a significant role in the KPU process. Major components of the system include Federal, State and local agencies, foundations, the conduct of R&D (institutions, personnel and activities), the formal school system and the public. Churchill included in his framework three educational sectors: public, task-oriented, and informal. However, the target educational system covered by the 1975 DATABOOK was the formal school system when it could be isolated. The context for our model of knowledge production and utilization is therefore considerably narrower than the Churchill framework but could be extended to include the task-oriented and informal sectors. The desirability of expansion is discussed in detail in Chapter 5 as we explicate problems encountered in compiling information for the DATABOOK. Whether or not an expansion is in order will be determined by policy decisions impacting on the referent system and monitoring goals.

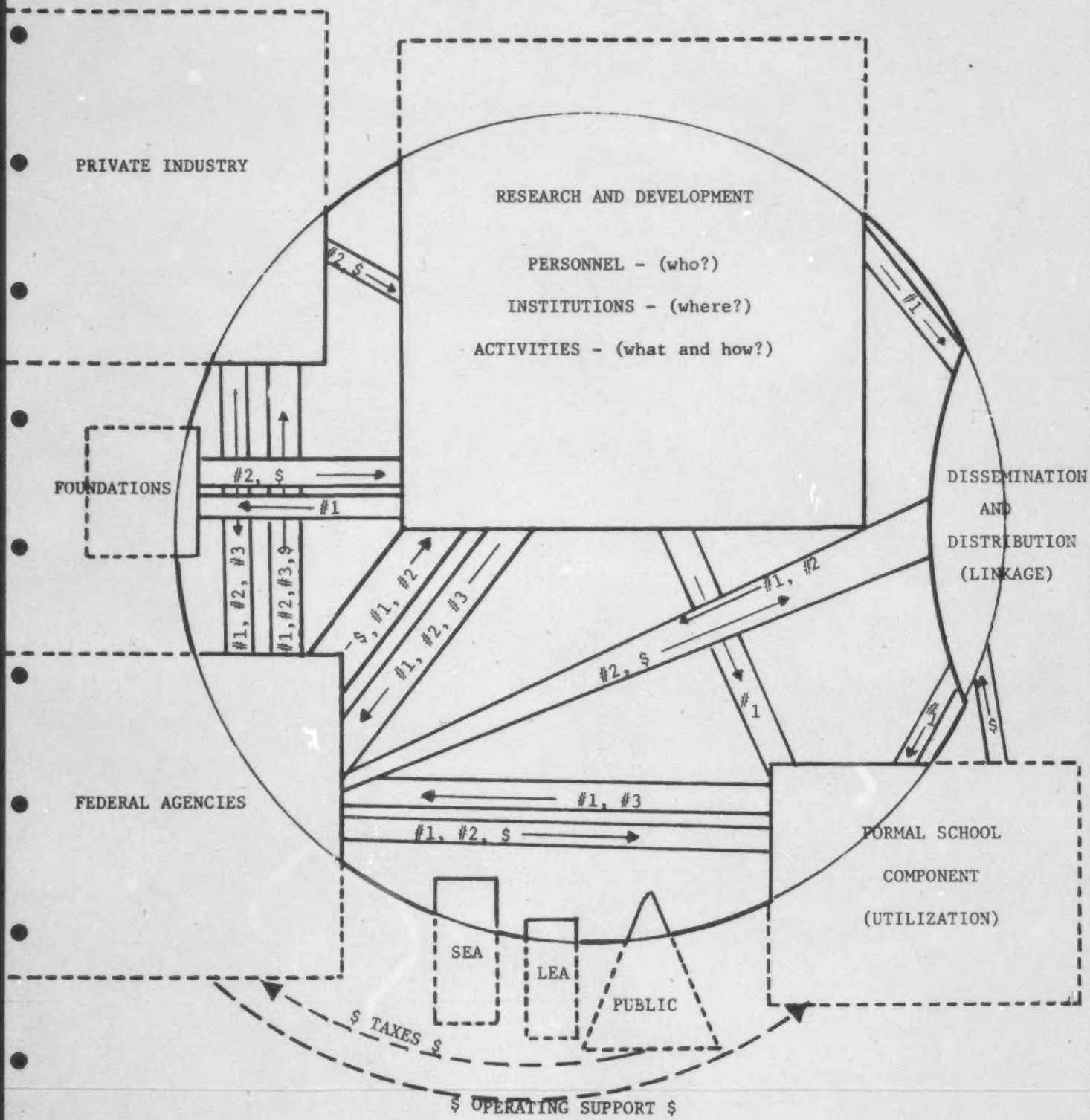
While the government agencies involved in educational KPU are not identified in Figure 3.E.1, indicators in the DATABOOK cover only those agencies directly involved.

(INSERT FIGURE 3.E.1 ABOUT HERE)

From the model it is obvious that parts of each component fall outside the system. This is true even in the R&D component in that researchers often devote much time to teaching or administration. While this poses problems for data

TECHNICAL REPORT FIGURE 3.E.1

A COMPOSITE MODEL OF EDUCATIONAL KPU,
EMPHASIZING FLOWS BETWEEN COMPONENTS



KEY: #1 - Product information
#2 - Directive information
#3 - Persuasive information
$ - Money flow

collection and requires definitional work for establishing indicators (see Chapter 4), it is accommodated by the model.

In a departure from prior models, we distinguish two types of flows through the system, i.e., money and information or information products. The nature of the information flow falls into one of three categories:

Info #1. Product: This consists of reports on the activity within a component or the products resulting from the activity within a component. Flowing from the R&D component are reports, papers, strategies, techniques, hardware, products, and other innovations. Product information from the formal school system takes the form of student achievement scores, evaluations, or some measure of graduates' preparation for employment. Product information of the involved government agencies takes the form of intramural research efforts or studies on the process of running the KPU enterprise. Cost benefit studies and cost effectiveness studies also fall into this category.

Info #2. Directive: This information communicates research needs. It identifies the problems or theories to be researched. Sponsors may transmit this information by offering support for specific, mission-oriented research, or they may allow others, such as researchers, to generate it. Congress, as a Federal agent participating in the KPU system, generates legislation which directs or authorizes research in a particular institution, problem area or discipline. Other government agencies establish programs, issue RFPs and contracts which obligate funds for specific research products. The research institutions and personnel may determine their preferencial research areas and problems which then are funded by the institution or through grants from public, private or foundation sponsors. Although the funding may come from an external source, this directive information is an output of the researcher. Directive information can also be concerned with market demand for products which leads to research and development, or media and public sentiment about unsolved problems in education.

Info #3. Persuasive: Implicated in this category are any forms of communication used to

influence KPU system actors. Information in category #1, or #2, may be employed in the service of this flow. Product information, such as an evaluation, may be used to convince policy-makers to increase support for particular research programs or products. Various congressional liaison personnel and procedures have been established to allow this form of information flow between some Federal agencies and others, between teachers groups or educational associations and the Congress, and from some research institutions to Congress. In many cases these contacts are informal and difficult to document.

Not all flows occur sufficiently between components, but consideration of the potential in some cases gives the model its heuristic value. A "system" is dependent upon the integration of its parts. Not only must all of the components be included in the model, but the channels through which they interrelate and communicate must be properly understood. It is also necessary to examine the nature of information which does not flow through these channels to consider what possible role it could have in improving the system.

Description of the model can begin at any point, and, by its recursive nature, we can return to whatever point is selected. We shall begin, as in the DATABOOK, with sponsorship.

Federal agencies and foundations carry the major responsibility for educational KPU system support. In addition, there is private industry involvement both as producer of R&D and as sponsor of independent efforts of researchers outside of industry. The activities of these institutions not involved in educational KPU are represented by broken lines falling outside of the KPU system circle in Figure 3.E.1. Money flows (sponsorship of research) are designated by arrows stemming from industry, foundations and government agencies to the R&D component. Currently little money flows from the formal school system to sponsor research, but there is expenditure for final products.

The system displayed in Figure 3.E.1 does not adequately reveal the role of private industry in KPU. We have deliberately slighted this component for several reasons. First, inclusion of all aspects of private industry involvement would over-complicate an already complex model. The addition of operational and marketing subcomponents for private industry, accompanied by the flow arrows required to connect these activities, institutions and personnel to the rest of the system would make this illustration uninterpretable. These aspects of private enterprise remain implicit within this component.

Private industry is also downplayed in Figure 3.E.1 due to the paucity of data available on it as a component of the KPU system. Little effort has been spent collecting data from producers of educational equipment, books or supplies. The terminology used for government sponsored projects does not mesh

with accounting figures that are available for private industry. Most of the private companies include R&D as part of operating expenses.

Additional complications arise as public KPU activities expand to include dissemination and marketing considerations. The inclusion of parallel private industry activities is prohibitive. Whereas dissemination of information on the development of educational innovations may be legitimate KPU activity, inclusion of similar behavior by private industry (e.g., advertisements for computer hardware) would inflate the measurement of private industry KPU. We might want to credit an appropriate portion of this activity to KPU (such as the percent of purchase cost that is added to cover the producers' investment in advertising computers to schools).

Many firms do commit considerable resources to the research and development of products utilized totally in the formal school system. These activities deserve a place in the KPU reporting system. The structure of formal education in America today depends heavily upon the books, film, ITV, materials, and environment designed and supplied by private industry. Without such participation by private industry, even greater public resources would necessarily be channeled into developing these products.

Measurement of private industry activity, while in large part absent from the DATABOOK, is recommended for the future. Once definitional problems are resolved, resulting in clearer conceptions of which aspects of private industry activity can be included in a KPU system, appropriate data collection can improve the efficiency of the total KPU system. Sensitive to problems raised by the secrecy often required in a competitive market, a data collection effort might reduce redundancy, delineate separate domains for private and public expenditures, indicate gaps in the present total KPU system, and spell out new directions for the public educational sector's attention.

Within each of the sponsoring agencies and the formal school system some research is also being funded and conducted. A set of descriptive process indicators based on this model would thus include the amount and distribution of monetary flows within components as well as between components.

Information flows can best be understood with reference to TABLE 3.E.1.

(INSERT TABLE 3.E.1 ABOUT HERE)

This Table lists the components of the educational KPU system and the information and monetary flows between them. These flows are inputs to a component, internal to a component, or the output of a component. Money flows within the system will be for the production, distribution or purchase of knowledge and knowledge related products and services. As illustrated in FIGURE 3.E.1, expenditures to keep the formal school system in operation are on the periphery of the system, but have been excluded from consideration in TABLE 3.E.1. DATABOOK sections related to particular information and money flows are noted in the righthand column of Table 3.E.1.

TABLE 3.E.1 Indicators of Educational KPU

COMPONENT	NATURE OF FLOW	CHANNELS	NO FLOW	NOT ADEQUATELY MEASURED	LOCATION OF RELEVANT MEASURES IN 1975 DATABOOK
Government Agencies (Congress, OE, NIE, etc., SEAs & LEAs)	$	Input to: taxes		% tax $ spent on Ed KPK	
		Internal to: fund appropriations, intramural research and development, funds for internal evaluation & assessment, state and local Ed. Agency funding		intramural all gov't conducted R&D	Section 3.B Section 3.D
		Output of: sponsorship of R&D, funds for diffusion and dissemination, funds to schools for final products		distribution of funds among research activities and institutions	Section 3.C Section 4.B Section 4.A
	Info #1 (product)	Input to: Research reports from other components. Evaluations		quality	
		Internal to: Intramural research reports, state and local reports, evaluations		quality coordination overlap of effort	Section 3.G
		Output of: Reports on the system, data bank maintenance, policy statements and reviews, research reports			
	Info #2 (directive)	Input to: Unsolicited proposals, requests or market demand for products, public pressure, educational problems	little flow from educators or public	private, industry role, educational problems to be solved, success rates or progress	
		Internal to: mandates, memos, legislation, program plans		effectiveness	Section 3.C
		Output of: establishment of programs, RFP's, contracts		distribution of information, availability of information	Section 3.C

TABLE 3.E.1 Indicators of Educational KPU (cont.)

COMPONENT	NATURE OF FLOW	CHANNELS	NO FLOW	NOT ADEQUATELY MEASURED	LOCATION OF RELEVANT MEASUR IN 1975 DATABOO
Government Agencies (cont.)	Info #3 (persuasive)	Input to: policy studies, lobbying activities, hearings and advisory committees, industry Internal to: interagency liaison Output of: regulation, information regulators	varies with agencies	time or $ devoted to self-maintenance	Section 3.C
Schools	$	Input to: funds from government agencies for school-based RDD&E and experimental programs local taxes and bond issues Internal to: allocation of funds between innovative vs operational activities Output of: funds to purchase educational products	no $ from R-D&D components to schools		
	Info #1 (product)	Input to: educational products, innovations, techniques Internal to: circulation of information within schools about products, techniques, innovations and innovators in the local environment Output of: reports, papers, evaluations, innovative practices generated in the local environment and transmitted to other practitioners, decision-makers and the public	doesn't reach R&D component	effectiveness of products what is going on in schools -- how much innovation?	Section 6.B Section 6.C

TABLE 3.E.1 Indicators of Educational KPU (cont.)

COMPONENT	NATURE OF FLOW	CHANNELS	NO FLOW	NOT ADEQUATELY MEASURED	LOCATION OF RELEVANT MEASUR IN 1975 DATABOC
Schools (cont.)	Info #2 (Directive)	Input to: directives from government agencies and legislation requiring testing and evaluation within schools - researchers intervention for studies Internal to: teacher generated experiments, requests for testing, practitioner innovation Output of: statements of problems of education failures of the system	communication with researchers	cost/effectiveness of intervention problems felt by educators, progress in solving them	Section 5.D
	Info #3 (Persuasive)	Inputs to: public pressure for new approaches, experimentation, influence on school boards Internal to: Outputs of: political lobbying by educational associations and teacher groups - evaluations, student achievement			Table 2.T.11
R&D (Performers)	$	Input to: funds from government, foundations, industry, sales, royalties Internal to: allocation of funds among activities in institutions and personal Output of: money spent for diffusion, marketing, advertising		distribution of funds for R&D	Section 3.C Section 3.D Section 3.E
	Info #1 (Product)	Input to: output of previous research, reports, literature, reviews, data bases			

TABLE 3.E.1 Indicators of Educational KPU (cont.)

COMPONENT	NATURE OF FLOW	CHANNELS	NO FLOW	NOT ADEQUATELY MEASURED	LOCATION OF RELEVANT MEASURE IN 1975 DATABOOK
R&D (Performers) (cont.)	Info #1 (Product) (cont)	Internal to: consortia, associations, conventions, journal articles, invisible networks, linkage mechanisms, ERIC			Section 4.C
		Output of: reports, papers, articles, books, reviews, evaluations, policy analysis strategies, innovation techniques, products	directly to schools	quality of products, focus of research	Section 6.C Section 4.D Section 5.B
	Info #2 (Directive)	Input to: government programs contract requirements, social and educational problems, legislation	from practitioners directly to researchers	source of directives	
		Internal to: peer pressures, characteristics of personnel, publish or perish pressures, department or institution policies, interests of scientists		personal institutions involved areas of focus	Section 4.C Section 4.B
		Output of: reports and policy analysis which establishes new directions, priorities for future research			
	Info #3 (Persuasive)	Input to:			
		Internal to: Old Boy network, training of new researchers	women's network		
		Output of: recommendations for sponsors, evidence and findings used in policy setting, lobbying efforts		utilization	
The Public	$	Input to: payment to participate in surveys, studies		public involvement	

TABLE 3.E.1 Indicators of Educational KPU (cont.)

COMPONENT	NATURE OF FLOW	CHANNELS	NO FLOW	NOT ADEQUATELY MEASURED	LOCATION OF RELEVANT MEASURE IN 1975 DATABOOK
The Public (cont.)	$ (cont.)	Internal to: Output of: taxes, school bond issues for innovative programs		passage of measures	
	Info #1 (Product)	Input to: media coverage, books Internal to: parent organization news, volunteer efforts Output of: votes for certain policies, officials	to researchers	coverage of educational issues in the media role of volunteers in schools	
	Info #2 (Directives)	Input to: early childhood intervention, programs involving the home Internal to: Output of: citizen action groups			
	Info #3 (Persuasive)	Input to: media, political propaganda Internal to: Output of: votes, lobbying, protest	little pressure specific to knowledge production		

Information input to government agencies (Federal,state and local) comes from the school component in the form of reports and evaluation (info #1) and pressure (info #3) to increase operational or training support. The lobbying activities of various school practitioner and administrator associations exemplify this. The amount of directive information (info #2) concerning research, development, or knowledge production activities flowing from the schools to the government is at present insignificant.

Information flows to the government from the R&D component consist of all three types (#1,#2,#3). Research reports and products characterize the product information (#1). Directive information (#2) concerning the type of research activities to be undertaken comes to the government in the form of unsolicited grant proposals. Persuasive information is conveyed through policy studies as well as lobbying activities.

The flow of information from the public and via the media is more sporadic. The media may raise issues concerned with school performance or future directions of society, but whether this has directive impact on policy regarding KPU depends upon individuals within sponsoring agencies. There are no institutionalized means for holding policy makers accountable other than the electoral process. Unfortunately for the KPU system, this link is too indirect. Voters cast their ballots on issues of greater prominence than a legislator's leadership on or responsiveness to educational research and development.

As a result, the media tend to raise issues which may or may not be made into causes for a politician (e.g. busing), the public may or may not become aroused about such causes, but rarely is there pressure from the media or public for rigorous research.

The information and money flowing into, internal to and out of the school and R&D components are spelled out in TABLE 3.E.1. As the model demonstrates, certain channels are more developed than others. Relatively little information or money flows between the school component and researchers. Recent efforts to make information products produced by researchers more accessible to practitioners is evidenced by the development of the Educational Resources Information Center (ERIC). Fewer resources have been devoted to facilitating the flow of information from the schools to the researchers. Linkage mechanisms are slowly beginning to seek directive information (info #2) from teachers concerning teaching problems they face and requesting solutions or products to alter educational situations.

The structure of the system revealed by the model also illuminates a rivalry between the operational school system and R&D activities. Government agencies, as the greatest source of funding for both components, must necessarily allocate education resources between the two. In a competition for fixed and limited resources, what the operational component garners, the R&D component cannot have. Were the two working in closer cooperation, i.e., with a better mutual flow of information, the output of the school component would be both improved and directly related to R&D activity.

Within each component of the educational KPU system are numerous variables which influence the system. In some cases, the 1975 DATABOOK presents detailed information for a component (e.g.,Sponsorship by the government). The factors limiting such thoroughness for each component are presented in the next two chapters of this report. When possible, we have included measures of resource distribution as well as totals. Reporting the levels of flows over time, even at a highly aggregated level, describes both the structure and process of the system.

We have emphasized system "flows" rather than "components" within this model to draw attention to previously neglected variables. These variables do not replace "components" in importance for the KPU system but do provide a new context to which measures of components can be related. Problems discussed in Chapter 4 were not the result of employing a particular model of the KPU system. Many characteristics of the data would have proved troublesome regardless of the model imposed. It is by relating the data to a model, however, that we are able to make recommendations for the future.

4. GENERAL PROBLEMS OF DATA COLLECTION AND ANALYSIS ENCOUNTERED IN PREPARATION OF THE 1975 DATABOOK

Innovative change in the field of education is dependent upon activities spanning the spectrum from basic and theoretical research to politically sensitive, decision-oriented and applied research. Progressive development of the educational system is impeded by problems plaguing the conduct of each investigatory approach, as well as by problems emerging from the attempted coordination of these activities. In compiling data for the 1975 DATABOOK we were confronted by the limitations of each aspect of the enterprise, as will be described below. This chapter will focus on the general problems of managing secondary data for the purpose of monitoring the educational knowledge production and utilization system in the U.S. To the extent of our understanding, we will recommend strategies to alleviate these problems for future monitoring efforts. In Chapter 5, we engage in more detailed discussion of information presented in each section of the 1975 DATABOOK, again with recommendations to improve periodic follow-ups.

4.A. OBJECTIVES OF THE 1975 DATABOOK

Before launching a discussion of the problems encountered in this project, we briefly remind the reader of the broader context by remarking on its objectives and accomplishments.

The 1975 DATABOOK represents the first effort since 1969 (Gideonse,1969) to accumulate information which: 1) describes the multi-dimensional, education-focused, knowledge production and knowledge utilization, system; 2) is aggregated at the national level; and 3) is presented concisely in one volume. Organization of the material is clear and straight-forward to facilitate use by nonspecialists, yet the level of detail and scope of coverage renders it applicable to the needs of informed administrators and policymakers. Areas which have not been adequately covered in recent studies are indicated in the text of the report. The 1975 DATABOOK establishes a baseline which can be adhered to, adapted, and expanded upon for future DATABOOK versions.

4.B. RELIANCE ON FEDERALLY SPONSORED STUDIES

As noted above, it was the purpose of the DATABOOK project to compile data describing the educational KPU system at a national level for the U.S. Examination of a multitude of source materials quickly revealed an unanticipated scarcity of useable data and the unequal distribution of research attention among areas of relevance to our inquiry. These conditions resulted from both conceptual and operational problems. On the practical side, projects designed to collect data at the national level are costly, requiring the time and cooperation of large workforces. We found that few comprehensive studies were undertaken unless financed by the Federal government. The utility of such studies for our purposes was constrained by conceptual and operational problems which can be characterized as:

1. The intersection of sets - The orientation, variables measured, and scope of monitoring studies is congruent with and dependent upon the authorizations establishing funding agencies or particular programs. Because interpretation of authorization is relegated to the individual agency, unless questioned by Congress, each agency chooses its own boundaries and the conceptualizations of its field. Few mechanisms for interagency coordination are successfully functioning. As a result, data that are produced in study x by agency A often overlap with study x' conducted by agency B but are rarely sufficiently isomorphic to provide validation nor sufficiently complementary to fill information gaps.

2. Administrative data - The majority of data collected by Federal agencies for national coverage is limited to administrative information, i.e.; information necessary for the management of a particular agency or program, rather than analytical or evaluative data. Such information is crucial for the functioning of Federal agencies but insufficient for intelligent internal decision-making and policy-setting. Generally, administrative data are collected in the normal course of agency operations and are limited to financial accounts. Notable exceptions which were used in the 1975 DATABOOK include studies of the National Science Foundation, the National Center for Educational Statistics, and the Office of Education.

3. Lack of coordination - Reported data on programs, projects and finances are collected for reporting on forms completed by individuals at different levels within agencies, institutions or organizations. Information requested annually by a variety of such forms is provided perfunctorily. Rarely are cross-checks undertaken to determine reliability and validity of information, adherence to variable definitions, or completeness of coverage Information requested for one inquiry is frequently supplied by individuals who are not responsible for, nor aware of, the information furnished for other

studies. Discrepancies occur concerning the activities or funding levels of particular programs or agencies, but these differences infrequently emerge from under the layers of reports to be read, and therefore are rarely cleared up. Currently, several interagency data coordination efforts are beginning (see 1975 DATABOOK, Section 3G) but results are not yet available.

4. Inability to disaggregate - Congress often appropriates funds to meet national needs in such a way that the research, development, personnel training, and operational aspects of programs are administratively viewed as one entity. In other cases, programs are broad enough to include other functions, such as health care. The managing agencies frequently do not maintain records of activities corresponding to the categories of interest to other agencies. Thus, for our investigation, few government sources outside of NIE were able to provide information on the educational research, development, dissemination or evaluation components of programs they supported. Highly aggregated data which met the needs of the managing agencies could not be disaggregated by the categories or level of detail we required.

5. Inappropriate labels - Sensitivity to the political and economic climate produces flexible self-definition within Federal agencies. New programs developed in response to political and economic pressures may or may not fulfill the intent of the legislation. As a result, monies earmarked for an activity, such as "innovation," may in fact be used to research new forms of instruction, or they may be used to sustain ongoing training programs. Characteristic labels for programs, such as "innovation," "demonstration," or "reform," fluctuate in accord with Congressional or Executive emphasis, but the actual activities conducted under such programs may more realistically reflect the interests of researchers, administrators, or program managers. The changing nature of activities complicated data analysis for the DATABOOK in that formal program descriptions did not correspond to ongoing research activities.

6. Lack of consistency - To accomplish the charge of presenting a comprehensive but concise overview of the educational knowledge production and utilization system within one volume, the 1975 DATABOOK was conceived to be a compilation of "indicators." As discussed in Chapter 2 of this report, on the indicator tradition, indicators are time series statistics.

   The requirement for data collected consistently over a number of years was frequently too restrictive for the information sources available. Time series statistics have been available for the operating school system on variables such as enrollment, districts, size of faculty and funding, since the end of the 19th century, but information on educational research, development, and utilization has been collected only sporadically and inconsistently.

   For the 1975 DATABOOK, we relaxed the requirement for time series data as the deficit became apparent. On certain topics for which consistent time series data are not available, we included information from multiple sources, particularly if somewhat comparable data collection had occurred over different time periods. These statistics are presented as rough estimates of past activity and possible trends rather than conclusive indicators or studies ripe for future replication.

4.C. ON DEFINING A DOMAIN

The 1975 DATABOOK was assembled without benefit of a clearly defined domain for educational research and development or educational knowledge production and utilization. This approach was appropriate for a first statistical overview of the terrain by NIE. It was necessary to begin by sketching in everything that could be relevant in order to determine what was. Some constraints were advanced by the Request For Proposals from which the DATABOOK developed. The RFP recommended limiting coverage to KPU targeted at the "formal school system including pre-school education, the K-12 system, and degree-granting post-secondary institutions (including professional and graduate schools)." It also suggested that this restricted focus for delivery systems be counter-balanced with a broad interpretation of KPU activities. Knowledge production and utilization, thus interpreted, includes research, development, linkage and utilization, under which "other activities, such as evaluation, demonstration, dissemination, diffusion, policy studies or policy research, adoption and implementation would be subsumed." (RFP p.3)

Data collection and analyses adhered to these guidelines whenever possible. However, as hinted above, two interrelated problems developed. First, unless we designed the instruments and collected new, primary data (which was generally not feasible due to time and financial constraints), little data conformed to these suggested (RFP) boundaries. Second, it was not a simple task to determine whether or not available data did fall within designated boundaries.

These problems were encountered in numerous contexts. We drew information for the DATABOOK from published books, reports, survey findings and articles, from interviews with researchers, analysts, practitioners and administrators, from raw data and knowledgeable correspondents. Obviously, our control over the boundaries imposed by others was limited. Published results were necessarily taken as they were presented and rarely had the concerns of prior researchers duplicated ours. Each survey or study had been designed to serve the purposes of a particular agency or to address specific issues. Even secondary analysis of raw data, which was undertaken in many cases, could not reshape the data to meet our requirements.

The reliance on studies conducted by others justified a flexible conception of educational knowledge production and utilization for construction of the 1975 DATABOOK. Allegiance to any one definition would have resulted in the elimination of several major data sources. Even with a loose approach, however, decision to include or exclude many sources was complicated. Discrepancies between sources entered at all levels, from subtle distinctions in the conception of "education" to dissimilar operationalizations of processes such as evaluation.

In many of the final reports produced by others, definition of "education" was not explicitly stated. In some of the more ambiguous cases it was possible to contact researchers or read individual project abstracts for clarification. In other cases we were forced to make judgments as to similarity of scope, and thus applicability of the information based on more subtle cues, such as who funded the project, how results were presented, what were the indirect or eventual implications for edcuation, how old were the subjects, or where the study was conducted. Studies bounded identically with ours along both "educational" and "KPU" dimensions were nonexistent. For some indicators we were able to piece together complete coverage based on several sources. In others we presented the available, reliable, information segments with appropriate explanation of data gaps.

4.D. WHAT IS EDUCATIONAL KNOWLEDGE PRODUCTION AND UTILIZATION?

The failure to generate a concise definition of "education" which can then be integrated with narrow or broad conceptions of KPU is excusable in light of the expansion "education" has undergone in the last decade. This growth has occurred along several dimensions, including the content of classes, vehicles and styles of instruction, age of population served, and relatedness to other aspects of life.

The topics or subject matter considered appropriate or essential for in-school instruction has increased unpredictably. As schools attempt to keep up with the changing demands society makes on its members, new areas of instruction are incorporated into the school curriculum. A certain number of years ago consumer education, sex education, career education (for girls as well as for boys), moral judgment and interpersonal communication skills were considered beyond the jurisdiction of the formal school system. Defining "education" when concerned with research and development further complicates conceptualization. This concern necessitates speculation on the relevancy of research questions in outlying or peripheral fields for future inschool instruction. Research on sexual development ten years ago would not, in all likelihood, have qualified for inclusion in a 1965 DATABOOK compiled under boundary constraints comparable to ours.

The media by which instructional materials are presented also increase and diversify each year. Children are exposed to games, slides, books, films, newspapers, videotapes, television programs, programmed instruction, computer programs and satellite-transmitted programs, all of which have intentional or unintentional instructional effects. Here again, in considering the scope of "education" it is unclear where to draw the boundaries. Many activities, such as watching "Sesame Street" at home on television, are clearly more educational than certain games played in nursery or elementary school classes and are increasingly included in considerations of "education." Often, the decision to consider a project educational rests more on who has funded it than on its substance, the assumption being that these two factors are significantly related.

In addition to deliberately educational television, however, children learn from much of the programming to which they are exposed. They learn pro-social and anti-social behaviors, what products to buy, and factual information (NIMH, 1972). This incidental learning is infrequently acknowledged in studies measuring "education."

Even when location of delivery, such as school, or deliberate instruction are posited as delimiters (as in the DATABOOK), boundaries are difficult to maintain. Some materials which are produced for private consumption, such as books or films, provide the focus for inschool study, while other deliberately instructive materials are the basis of home study correspondence courses.

Estimating the productivity of research and development for education is complicated by the structure of private industry. First, we are unable to disaggregate by function the proportion of labor and capital employed to develop technology which will be used for educational, as well as noneducational purposes. Although total sales to the educational sector from segments of the industry are available data, it is not possible to isolate research and development expenditures. The terminology within private industry is dissimilar so that these costs are included under operating costs. Marketing activities for private industry are somewhat comparable to dissemination in the nonprofit and public RDD&E ventures. The proportion of funds expended for this aspect of innovation, as opposed to R&D, was much higher in private industry. New programs

in the public agencies have been designed to compensate for this difference. However, total marketing or dissemination expenditures for the educational KPU enterprise have not been computed.

As the United States moves rapidly into a post-industrial society (Bell, 1973), into a knowledge production and distribution society (Machlup, 1962), and into an information society (Parker and Porat, 1975), the distinctions between "education" and "information" activities become more, rather than less, blurred. Informative materials are accessible all the time, in many locations, and covering many subjects as well as skills. Can "education" be contained in the classroom? Learning how to operate the new technologies (e.g. calculators, cars, computers) may or may not take place in the school, yet these skills are fast becoming critical for success in this society. If these trends continue, a simple conception of "educational KPU" will be increasingly difficult to maintain.

Concurrent with, and perhaps as a result of, the proliferation of informational and instructional materials, new segments of the population have been offered "education." Educational programs now can begin in infancy and extend throughout life, presenting developmental skills, traditional and new courses of instruction, education for new roles, such as parenthood, or vocational training. In addition, innovative approaches for the instruction of special groups, such as the handicapped, or the gifted, diversify further a comprehensive understanding of "education."

4.E. ESTABLISHING BOUNDARIES

Whereas until this time a definition of educational KPU was perhaps premature, and certainly subject to radical reconceptualizations, once we have acknowledged the utility of monitoring the KPU system it is critical that a flexible but basically consistent conception begin to emerge. In particular the need to establish boundaries for educational knowledge production and utilization predominates in any attempt to collect primary data on the system, replicable over time.

For any conceptualization of "educational KPU" to endure the multi-dimensional growth of the system, the following characteristics are desirable:

1. Realistic correspondence with the substance, scope, and methodological approaches of current activity in the system;

2. Capability to predict research concerns that will be recognized in the future as relevant to educational change so that measurements will be consistent over time;

3. Utility for individual researchers and practitioners, as well as staff of agencies or

coordinating mechanisms concerned with the subject; and

4. Utility for policy-formulation of agencies focused exclusively on this activity, such as NIE. The information needed by such agencies will be at a lower level of aggregation; however, external boundaries can be maintained.

Educational knowledge production and utilization will not emerge as a simple construct, operational and measurable as one entity. Any singular definition falls short along particular dimensions. Definition of focal variables or enumeration of items to be included or excluded are frequent approaches taken in data collection efforts, but the results are then inapplicable to the needs of others. In the past, agencies collecting data, such as NSF, have specified definitions for the processes (e.g., "basic research" or "development") but have allowed flexibility in the interpretation of function areas (e.g., "education" or "health").

The alternative to definition or no definition is generally seen as a rigorous taxonomy. Various taxonomies and classification schemes have been developed or are currently under development. Each fails on at least one of the desirable characteristics. The NSF categories are additive so that projects which may fit appropriately in more than one category must be counted only once. The limitations of this approach are suffered to varying degrees, dependent upon the interest level of information users. Such highly aggregated data are useful to reveal the position of educational R&D relative to all R&D but inadequate for monitoring the educational KPU system.

Current proposals by the General Accounting Office for a comprehensive classification scheme for Federal R&D again organizes categories for education in a manner which diminishes utility for educational KPU monitoring. The content or substance dimensions of "education" are confused with knowledge production and utilization processes. Although the GAO plans to collect data on a project level, if aggregated by an inappropriate classification, the information will be useful only in raw form. The Office of Management and Budget's Special Analysis for Education is also inadequate for the monitoring of KPU due to the level of data aggregation. These data series are discussed in greater detail in Chapter 5 of this report.

Perhaps the most detailed taxonomy for educational R&D was developed by the National Center for Educational Research and Development in 1970. Certainly, a taxonomy which can meaningfully organize the activities pursued in educational knowledge production and utilization fields would be beneficial for monitoring the system as well as for researchers engaged in the system. Unfortunately, the development of a taxonomy detailed at the level of NCERD's effort is unlikely to maintain a consistent fit with reality over time.

A compromise between a definitional approach and a rigorous taxonomy may be in order for monitoring the KPU field. One possibility is the development of a flexible, modular construction of boundaries within which components can be specified and viewed as a totality or individually. The overall scope of these modules can be determined by policy decisions rather than awaiting theoretical

conclusions. For the most part these should be high level agency decisions to insure consistency in policy, data collection and reporting. These determinations will rest on the role conceived for educational KPU. Here we must step back to view the role of education in the social system.

Within the social system education is regarded as a social function. The Educational KPU system is aimed at improving society's ability to perform that function. Educational KPU indicators monitor the condition and performance of the KPU system over time as it attempts to improve society's ability to perform the educational function. The goals of the educational function are determined by the political and economic structure of the society, by the values and priorities of the society, and by the resources of the society. The research activities of KPU do not establish the goals for education. They do document and evaluate how well the educational system is performing. In addition, research can affect how well the function is performed by increasing the basic and applied knowledge base.

Currently, policy consistent with the goal of monitoring the KPU system may entertain any of the following interpretations of "educational knowledge production and utilization:"

1. Narrow interpretation - agency efforts and resources are associated with a particular environment, population, or institution, such as the formal school system. Perhaps only deliberate attempts to instruct are focused upon. While the scope of this task may shrink relative to total information activities, a consistent allegiance to the school criteria would produce, over time, the history and tools with which to improve the formal school system.

2. Eclectic Interpretation - Political information, the interests and expertise of researchers, as well as funding constraints allow the boundaries of educational KPU to fluctuate. Under this interpretation, reports on the system attempt to cover the areas currently under close scrutiny by politicians, legislators, the public and the media. Consistency and thoroughness in monitoring are subordinated to timeliness.

3. Broad Interpretation - The educatioanl KPU system can be broadly conceived to encompass the learning experiences of Americans. This interpretation admits the dynamic nature of education today and attempts to chart its development over time. As the conception of learning expands, the number of agencies participating in this area and the conflict of

authority will increase. Pursuit of monitorship along this interpretation requires the resources to collect primary data on all relevant programs at a project level, or the coordination of existing agencies and their data collection activities.

A monitoring system constrained by one of these interpretations must be oriented to the task set for it within these boundaries. The task, as we have stated it above, is to report on the condition and performance of educational KPU. To determine how well the system is performing, certain tasks must be set for it (the KPU system itself) as well. According to the model explicated in Chapter 3, these tasks are embodied in directive information flowing between components. The directives may be in the form of proposals to do research; requests, contracts or legislation for research activities; or the statement of educational problems needing solution.

Indicators of this sort are scarce in the 1975 DATABOOK due to a lack of data collected from this perspective. In looking for outcomes of the KPU system, critics unfairly note the outcomes of schools (e.g., the achievement, assessment or employability of students). These measures are too indirect and contaminated by numerous variables beyond the researcher's, the developer's, or the disseminator's control. However, until outcomes of the educational KPU system are directly measured, accountability will rest on the outcomes of education itself.

In addition to documentation for the sources of directive information and relative accomplishment rates, the opinion of the public, educators, and other spokespersons on educational problems to be solved will help to set goals for KPU. The quantity of output in educational KPU is not an adequate indicator of performance. Output related to specific tasks would be. These tasks need not be "applied" research. The output of basic research is the advancement of knowledge. Citation studies provide one indication of such progress.

Tying the performance of educational KPU to the problems posed and the problems solved does not eliminate the need for input and process variables. Knowledge of resource (information and money) distribution among the components and internal to the components is critical in monitoring the system.

Statistics for some of the money and product indicators have been available for the 1975 DATABOOK in the form of administrative data maintained for government agency operation. Again, statistics on the directive and persuasive information inputs are largely nonexistent. Measurement of liaison activities, lobbying activities and informal regulators would contribute to our knowledge of the system's condition and our eventual understaning of its performance.

The orientation towards tasks or goals set can be extended further in our analysis of KPU. Movement in this direction is already in evidence with the establishment of programs targeted at particular educational problems (e.g., NIE's Basic Skills) but system monitorship has generally not been organized in this manner.

Assuming that system boundaries have been determined by policy decisions based on an interpretation similar to one suggested above, the need for specification of components within those boundaries becomes critical in data collection and analysis.

There are four processes through which data for monitoring the KPU system can be gathered:

1. Reference to publications and data services produced or maintained by others;

2. Use of raw data collected by others, manipulating it to conform with monitoring goals;

3. Collection of raw data through piggy-backing on others' ongoing studies;

4. Independent collection of raw data.

Each of these procedures has different implications for a monitorship attempting to impose its own boundaries. The cost to a KPU monitoring agency increases as one moves from the first to the second, third, and fourth types of activity. Likewise, the utility tends to increase as the agency has the opportunity to manipulate raw data or, optimally, to collect its own.

An hierarchical organization of tasks can assist in deriving optimal utility from information extracted through each process. Rather than propose a particular task hierarchy here, which would likely be contested, we will explicate the principle.

Working from the base up, raw data and information collected at the project level can be organized according to the tasks set or the research questions asked. Multiple coding of goals would allow desirable flexibility in data analysis. The problems posed in individual projects would necessarily be detailed and explicit. Where focal problems are not determinable from project descriptions, the continuance of such work might be questioned.

Inclusion/exclusion decisions are based on policy-established system boundaries and relevance to a problem or task area, rather than arbitrary distinctions drawn between terms such as "manpower training" and "demonstration." If this information is collected via survey, respondents could signal the KPU process (e.g. basic research, demonstration, evaluation, etc.) involved as well as the task. Specificity of task categories will be determined by the resources available for the effort.

Further up in the hierarchy, generally at program level descriptions, the problem statement will be broader and more general. Here again, multiple coding will permit programs with relevance to several problem areas to be double counted. Keeping in mind that accountability should rest on tasks accomplished,

inclusion of programs under particular task categories might be determined by the proportion of their resources expended for the attainment of that particular problem solution.

At the top of the task hierarchy is the problem with which we began, i.e.; improving the ability to perform the "education" function.

The "task" oriented approach reverses usual priorities for monitoring the KPU system. In the past data have been collected on components of the system such as institutions conducting research or disseminating the results. The substance of research activities has been poorly reported. Although gross estimates of the distribution of funds among substantive areas are available, we have little information on the specific tasks being set for research and development. A shift of emphasis onto "tasks" might still disaggregate data by institutions, but indicators of the flow of resources for particular tasks would be central to the monitoring effort.

The "mission" orientation of much legislation is conducive to the "task" approach. Legislators often respond to public or media pressure by passing bills aimed at solving problems. A monitoring system organized to measure the resources focused on tasks is more likely to produce data that is meaningful for the public, for legislators and researchers, as well as for administrators.

Chapter 5 is composed of critiques of individual data series we reviewed for the DATABOOK. In addition to discussion of the conceptual and methodological aspects of the data series we have included recommendations for future data collection and analysis efforts directed toward the construction of a monitoring system for educational KPU.

5. DATA CRITIQUES

5.A. INTRODUCTION

In the following pages each data set or series included in the 1975 DATABOOK is critiqued. Also reviewed are many data sources discussed briefly in the DATABOOK and some materials judged inappropriate for the 1975 DATABOOK. These reports are intended to facilitate future KPU monitoring activities.

Each critique provides information on the source and availability of the data, methodology, and the variables and sample covered in data collection. Factors affecting the reliability and validity of the data series and considerations bearing on the utility of the information for monitoring KPU are discussed. When possible, recommendations are made for the improvement of a particular data series. On certain topics our recommendations go beyond individual indicators. These ideas are presented at the conclusion of data category sections.

The organization of this chapter follows the presentation of data in the 1975 DATABOOK. We have excluded from discussion indicators of the school operating system. These indicators are drawn from publications of the National Center for Educational Statistics and the Office of Education or the National Assessment of Educational Progress. Technical notes on them can be found in the referenced sources.

DATA CRITIQUES AND RECOMMENDATIONS

DATABOOK CHAPTER: 3. SPONSORSHIP OF EDUCATIONAL RESEARCH AND DEVELOPMENT

SECTION: C. Federal Funding of Educational R&D

DATA SERIES REVIEWED:

Federal obligations for educational R&D from the NSF perspective: 1969-1975.

Federal obligations for educational R&D from the OMB perspective: 1974-1976.

Obligations for educational R&D not included in the NSF and OMB perspectives: 1975.

Information resources of NIE.

The Interagency Panels for Research and Development Activities Relating to Early Childhood and Relating to Adolescence.

Survey of Federal Financed Social Problem Research

Name of data set or data series: Federal obligations for educational R&D from the NSF perspective: 1969-1975.

Source, availability, and documentation of data:

The figures presented in the 1975 DATABOOK were submitted by Dr. Benjamin Olsen for NSF's R&D Economic Studies Section - 202 -282 - 7748. These data are available for further analyses and are updated annually. The data on R&D for education and thirteen other functions are published in AN ANALYSIS OF FEDERAL R&D FUNDING BY FUNCTION each year.

Procedures of data collection:

Agencies submit forms with the amount obligated for R&D totalled. They also supply descriptions of the programs included. These descriptions vary in detail, specificity and clarity concerning which function they serve. The function decision is made by NSF staff if not specified in the form. Staff accept individual agency suggestions and preferences in classification but these may change from year to year. When agency personnel change, the descriptions of programs may change as well as their assignment to a particular function. Programs are categorized by their primary function and may not be double counted.

Major variables included:

All Federal programs judged relevant to R&D by the sponsoring agency are included. The amount of obligation is totalled across agencies for each of fourteen functions.

Reliability, validity, and utility of data for NIE monitoring:

Several factors affecting the utility, reliability and validity of these data are discussed in the DATABOOK. These are reviewed and expanded upon here.

1. Only programs with a primary focus on educational R&D are included. This avoids double counting so that amounts may be aggregated to provide total Federal R&D obligations. However, it provides a low estimate of educational R&D by eliminating all programs under this function that focus on education or R&D as the secondary emphasis.

2. Coding procedures are flexible. Agencies may make functional category shifts in reporting their data or request that NSF staff do so. The figures presented in Section 3.C are a preliminary revision of the data for several years. Funds that had been expended through an agency now defunct (OEO) have been assigned to NIE for years prior to NIE's establishment. This organization of data frustrates the attempt to follow the logic of Federal funding for educational R&D.

3. NSF uses a constricted definition of research and development (see attachment NSF). This narrow interpretation of R&D excludes programs mainly concerned with dissemination, evaluation, implementation, demonstration or utilization. These distinctions are not maintained consistently.

4. Funds given to states under revenue sharing by OE, which may be used for R&D are not included in these reports.

5. The level of aggregation is higher than optimal for KPU monitoring. It is most useful for cross-function comparisons and can serve as a reasonably stable time series. NSF has gone back in the past few years to reanalyze data so that trends can be observed. The explicit and extensive technical notes accompanying each NSF report properly qualify their findings.

ATTACHMENT NSF

The National Science Foundation provides the following definitions for Research and Development:

a. Research is systematic, intensive study directed toward fuller scientific knowledge or understanding of the subject studied. Research is classified as either basic or applied.

In basic research the investigator is concered primarily with gaining a fuller knowledge or understanding of the subject under study.

In applied research the investigator is primarily interested in a practical use of the knowledge or understanding for purpose of meeting a recognized need.

b. Development is systematic use of the knowledge and understanding gained from research, directed toward the production of useful materials, devices, systems, or methods, including design and development of prototypes and processes. It excludes quality control, routine product testing, and production.

These definitions are taken from the NSF publication "Federal Funds for Research, Development, and Other Scientific Activities, 1974 (p. 50). Data collected for this study were used to produce "An Analysis of Federal R&D Funding by Function, 1965-1975."

Name of data set or data series: Federal obligations for educational R&D from the OMB perspective: 1974-1976.

Source, availability, and documentation of data:

NIE staff constructed this table by converting the outlay* figures for agencies or programs included in the OMB Special Analysis of education to obligations. Mr. Rothbart at OMB furnished information on included programs that was aggregated at a lower level, but would not provide access to the raw data.

Procedures of data collection:

All Federal agencies are required to submit budgetary information to the Office of Management and Budget. The Special Analysis of Education is based on program level information thus provided. OMB looks at outlays for personnel training and research in education separately.

Major variables included:

All Federal programs and their expenditures for a functional category. Research activity is grouped with "general education aids" providing a broad interpretation of education. Library services and cultural activities are included.

Reliability, validity, and utility of data for NIE monitoring:

The outlay figures on which this table is based depart from the current NIE perspective on educational KPU by broadly encompassing total programs that may only in part relate to R&D. Inclusion of most activities undertaken by the National Endowment for Humanities is an example. It is impossible, with data as highly aggregated as necessary for OMB purposes, to separate out the parts of programs providing services rather than R&D. The conversion from outlay to obligation performed for this table is an estimate and would have to be obtained on a program by program survey for precision. Although these data cover many more agencies than NSF, numerous additional programs deserve inclusion.

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* See attachment for distinction between "obligation" and "outlay."

Distinction between "obligation" and "outlay"

Obligation: Commitments made by federal agencies to pay for products or services. These are different from the actual outlay and may not result in an actual payment for several years. For example, the agency might sign a contract for delivery of goods two years in the future. The obligation is incurred in fiscal 1976, and the outlay occurs in fiscal 1978.

Outlay: The issuance of a check for goods or services or payment of interest on the federal debt. Outlays are estimated to total $349.4 billion in fiscal 1976. Of that, $237.8 billion comes from new budget authority and $11.6 billion comes from unspent authority from previous years.

Definitions are taken from "A Glossary of Budget Terms" prepared by James L. Rowe, Jr. for the Washington Post.

Name of data set or data series: Obligations for educational R&D not included in the NSF and OMB perspectives: 1975.

Source, availability, and documentation of data:

Unpublished data collected by the R&D System Support Division of the Dissemination and Resources Group of the National Institute of Education.

Procedures of data collection:

Data collection occurred in summer, 1975. Several procedures were followed:

1. Review of materials such as reports, tables and raw data, furnished by other agencies.
2. Interviews in-person or via telephone with appropriate personnel at other agencies.
3. Requests for written program descriptions and obligations to be furnished by appropriate personnel.
4. Review of project level abstracts maintained by the Smithsonian Science Information Exchange and the Interagency Panels on Early Childhood and Adolescence.

Major variables included:

Programs excluded by NSF and OMB that sponsor educational R&D.

Reliability, validity, and utility of data for NIE monitoring:

These data are a first attempt to refine the measurement of educational R&D sponsorship by the federal government for the purposes of monitoring KPU. This effort was impeded by the lack of a definition for educational KPU or R&D (see chapter 4 of this report) and by the shortage of time and resources that could be committed to this data collection effort. Much useful information was collected and the experience gained will improve future monitoring efforts.

Recommendations:

The extensive descriptions of programs and agency activities relevant to educational KPU compiled by NIE staff for the DATABOOK project should be maintained and updated. However, this may be an appropriate task for an inter-agency coordination mechanism such as the FICE subcommittee on educational R&D rather than for NIE. To monitor the functioning and performance of educational KPU NIE has need of more specific and focused information. Recommendations based on this line of reasoning are elaborated at the conclusion of this section.

SPONSORSHIP RECOMMENDATIONS

The discrepancy between OMB estimates and NSF estimates of Federal support for educational R&D, plus the existence of additional programs identified by NIE staff suggest the need for new measurement. NSF and OMB have analyzed data at the Program level. NIE staff compared Project level data with Program obligations to derive their best estimate of activity omitted by NSF and OMB. The General Accounting Office is currently planning a project level study for the purpose of introducing additional accountability for R&D across all Federal agencies. GAO staff have constructed a taxonomy for R&D that includes education as one of approximately 12 sectors. Education is subdivided into five categories:

1. Improving fundamental knowledge concerning the learning process.
2. Curricula and subject matter.
3. Improving the understanding of the societal role of education.
4. Special considerations in education (ethnic, economic, linguistic and gender related problems).
5. Education delivery.

Research on training of professionals and other workers for certain jobs is to be included but other activities such as product development, dissemination, and utilization may not be.

NIE staff has had the opportunity to comment on this classification scheme. GAO's response to the suggestions offered has been ambiguous. Despite the limitations of this taxonomy for monitoring educational KPU, advantage can be taken of the data collection activities. The massive effort of gathering data at a project level from all Federal agencies need not be replicated by NIE. Projects falling outside the GAO study boundaries could be gathered independently by NIE.

Depending upon the data collection methods GAO employs, NIE can attempt to arrange for 1) receipt of duplicate abstracts from relevant agencies, 2) duplicate responses to GAO questionnaires, or perhaps even 3) the opportunity to add a few questions to the data collection forms that will produce data to be analyzed by NIE. Analysis undertaken by NIE does not have to follow the classification scheme created by GAO if granted access to the raw data.

Before any major data collection or analysis activities are embarked upon for monitoring KPU, conceptual issues must be confronted. In Chapter 4 we have argued for political decisions on the scope of educational knowledge production and utilization. Certainly these decisions will be made on the basis of theoretical and practical factors

discussed by researchers and administrators, as well as on the political feasibility judged by policy analysts.

This approach to setting boundaries is preferable to defining terms such as education or knowledge. Their meaning will shift over time invalidating any constraints placed on them.

The analyses conducted by NSF, OMB, and GAO will provide three different estimates of total Federal support for educational R&D. None of these agencies will make inclusion/exclusion decisions exactly as NIE would but they will provide sufficient data for comparing educational KPU support with that of other functions. The utility of an additional gross estimate of Federal obligations for educational KPU produced by NIE would be minimal. Instead, NIE needs measures more sensitive to the particular tasks, activities or problems being studied.

We have proposed, in Chapter 4, the development of a task hierarchy within the boundaries established. Arriving at an acceptable task hierarchy is an enormous conceptual task. There are several strategies possible for developing the hierarchy.

1. A hierarchy can be based on prior organization of research missions as established by Federal legislation.

2. The establishment of programs within agencies generally follows a purposeful logic which could be extended to structure an hierarchy.

3. The National Institute for Education might develop the conceptual structure as a policy position, or contract with a team of researchers to do so.

4. The opinions of a large group of interested constituencies might be represented. These data can be collected in interviews, a survey, or using a delphi study. The diverse groups that might want to be involved (researchers, practitioners, students, the public, parents, the media, administrators, and policy makers) in suggesting "problems" for educational R&D conforms nicely to the format of a delphi study. Using this technique, the population, or a stratified sample is queried for suggestions. The questioning proceeds through several reiterations gradually narrowing the selection possibilities. Final decisions and guidance are the responsibility of NIE.

Name of data set or data series: Information resources of NIE

Several tables in the DATABOOK were produced from administrative data accumulated as a consequence of program operations.

A new internal Data Management System has been created for NIE which will maintain the following data files:

1. NIE Awards - Information will cover the title, DHEW code for NIE office, dates of starting, ending and signing, type of competition, obligation amount, total cost over all years, primary site of research, state, district, NIE priority, negotiator, PI or project director, address, ERIC descriptors and abstract.

This information will be published annually. It is possible to query the system and to request other reports based on the computer bases maintained.

2. Vendor-coded file - The institution and persons receiving awards.

3. Competition announcements.

4. Financial information.

5. Applications submitted for grants.

Information on contracts is provided by NIE contractor's office; information on grant applications obtained from applicants as part of the application.

This system promises to provide data useful in managing NIE internally as well as in developing reports for outside agencies on the activities of NIE. As the system matures and data collection and analysis become more routine it may be possible to expand the data files currently maintained.

NIE is involved with the following information resources through the Educational Resources Division:

1. Educational Resources Information Center (ERIC) - see separate critique.

2. EDUCATIONAL RESEARCH IN PROGRESS - This is an interim project that will be replaced by the activities of the Data Management System when it is in full operation. EDUCATIONAL RESEARCH IN PROGRESS is a compilation of approved and on-going research projects of the NIE. There are 24 data elements for each award recorded.

3. Educational Reference Center - A service through which it is possible to query ERIC files and files of 19 other data services.

4. A microfiche service for documents rejected from ERIC that are reports of projects funded by OE or NIE. This service is not yet available.

5. On-line bibliography of all NIE library contents. This project is still in the planning stages.

6. Archives booklet to be published twice a year. It will contain a list of all past awards and possibly, abstracts of the projects.

7. Products library - This Division is also planning to display a sample of each product developed with NIE support.

The extensive amount of information produced by these services and data files will merit much analysis and interpretation. None of these efforts, however, cover projects sponsored by outside agencies (with the exception of the microfiche collection which includes the reports sponsored by OE but rejected for inclusion in ERIC).

As NIE becomes more firmly established the collection and analysis of data and the maintenance of data files on the activities of outside agencies needs to become an intregal part of its monitoring role.

Name of data set or data series: The Interagency Panels for Research and Development Activities Relating to Early Childhood and Relating to Adolescence.

Source, availability, and documentation of data:

Annual reports, tabulations, lists, raw data, and project abstracts are available from the Social Research Group, George Washington University, Washington, D.C.

Agencies participating in the Panels are listed in the 1975 DATABOOK.

Procedures of data collection:

The Panel staffs collect and code the projects from the member agencies. Approximately 14 agencies participate and as of December 1974, over 3000 projects classified by 525 descriptors were included in the computerized data file.

Major variables included:

Detailed information about a project's funding and duration, sample characteristics, purpose, methodology and data collection techniques, areas of research focus are collected and available. The names of sponsoring agencies and principal investigators are also available.

Reliability, validity, and utility of data for NIE monitoring:

These data files provide an excellent source for NIE monitoring efforts. Although they are not comprehensive for the educational KPU domain (e.g. excluding NSF and all higher or adult education), the information system fills certain gaps for monitoring KPU and provides a model that NIE may wish to emulate.

Recommendations:

Tables from the reports of the Interagency Panels have not been included as indicators of educational R&D because they are not comprehensive indicators nor do they represent complementary partitions of the fields they cover. If future NIE monitoring efforts take a task or problem oriented approach, these data will prove more useful.

Name of data set or data series: Survey of Federal Financed Social Problem Research.

Source, availability, and documentation of data:

National Academy of Sciences
(no further documentation)

Procedures of data collection:

Federal agencies furnished data on programs concerned with R&D on social problems. Data were collected in the summer of 1974.

Major variables included:

These data cover all social problems, not just education. They do not include programs focused on technology so that educational technology studies would be excluded.

Reliability, validity, and utility of data for NIE monitoring:

These data are not included in the 1975 DATABOOK but they exemplify one of the major problems encountered in data collection efforts for the DATABOOK project. The universe investigated in this study intersected with educational KPU. However, the degree of overlap was indeterminable from the data collected.

Recommendations:

DATA CRITIQUES AND RECOMMENDATIONS

DATABOOK CHAPTER: 3. SPONSORSHIP OF EDUCATIONAL RESEARCH AND DEVELOPMENT

SECTION: D. State and Local Funding of Educational R&D

DATA SERIES REVIEWED:

NSF's Research and Development in State Government Agencies (1964-1965; 1967-1968; 1972-1973).

State Educational Assessment Programs, 1973 Revision, Educational Testing Service.

Name of data set or data series: NSF's Research and Development in State Government Agencies (1964-1965; 1967-1968; 1972-1973)

Source, availability, and documentation of data:

These studies were prepared under the direction of Benjamin Olsen, Government Studies Group. Raw data as well as aggregated tabulations are available to NIE staff.

Procedures of data collection:

Questionnaires were sent to all state agencies with a prior involvement in R&D activity by the Bureau of the Census, Social and Economic Statistics Administration, Department of Commerce. The universe consisted of all fifty states, excluded state universities and their affiliations. A total of 1309 agencies were surveyed with 1276 responding. The function (e.g., education, health) assigned to each agency project was determined by NSF Government Studies Group Staff.

Major variables included:

Data were sought on funding, personnel requirements and the nature of R&D programs. Personnel categorized as a) scientists and engineers, b) technicians, c) other, are summed to full-time equivalents thus causing the total to look extremely low.

Reliability, validity, and utility of data for NIE monitoring:

The high response rate to this survey in general allows us to accept the findings. On certain variables such as R&D expenditures, however, the response rate was as low as 40.7% in 1972-1973. The bias introduced by gathering data from only one indivudal at each agency cannot be determined, but must be recognized. These are useful data for NIE as far as they go.

Recommendations:

These studies are periodically undertaken by the Bureau of the Census for NSF. According to NSF staff, the main determinant of frequency is funding. The possibility of including questions targeted at educational R&D personnel and activities should be explored.

Name of data set or data series: State Educational Assessment Programs
1973 Revision, Educational Testing Service

5.15

Source, availability, and documentation of data:

The Center for Statewide Educational Assessment is no longer in existence, and data on State Assessments is not being coordinated by ETS but the 1973 report is available from ETS. (Paul Campbell at ETS: 609 / 921-9000. Other suggestions - Mary Hall at the State Department of Education in Oregon may have more recent data on certain states.)

Procedures of data collection:

Information was collected by questionnaire and interview with members of each State Department of Education. A prior study had been conducted in 1971. No future comparable study is planned.

Major variables included:

Educational assessment activities by state: goals of activities, target populations, funding sources, target areas (e.g. math, attitudes, self-concept, etc.), data collection and processing, use of data, response to program, future of assessment program.

Reliability, validity, and utility of data for NIE monitoring:

According to ETS staff, vast changes in state assessment over the past two years have rendered much of the information contained in the report obsolete. It is still useful to exemplify a clear and thorough presentation of data. Certain variables of interest to NIE such as research personnel are not covered.

Recommendations:

Better data on state level KPU activities is required. An attempt to coordinate data gathering with NSF is recommended on the preceding page.

DATA CRITIQUES AND RECOMMENDATIONS

DATABOOK CHAPTER: 3. SPONSORSHIP OF EDUCATIONAL RESEARCH AND DEVELOPMENT

SECTION: E. Foundation Funding of Educational R&D

DATA SERIES REVIEWED:

Activities of the Foundation Center.

Name of data set or data series: Activities of the Foundation Center

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Source, availability, and documentation of data:

The Foundation Center is responsible for three data sources on foundations:

1. "Foundation News" - a bimonthly publication containing articles relevant to foundations and philanthropy as well as a listing of grants recently awarded.

2. FOUNDATION GRANTS INDEX - a compilation of grant descriptions listed in "Foundation News." The index is updated with each issue of "Foundation News." Information is organized by State of foundation, overview of grant recipients, and subject matter of grants.

3. THE FOUNDATION DIRECTORY - listing of foundations. Includes information on date and form of organization, address, names of donors, purpose and description of activities, names of officers and trustees or directors, statistics for the year of record (1972 or later): assets, gifts received, total grants, number of grants paid, highest and lowest grants.

Procedures of data collection:

Data are submitted voluntarily by the granting institutions. Therefore, some foundations and some individual grants are excluded. The Foundation Center staff will make efforts to enlist the cooperation of institutions they are made aware of.

Computer searches are available to Associates of the Foundation Center only.

Major variables included:

See above under individual data sources mentioned.

Reliability, validity, and utility of data for NIE monitoring:

The Foundation Center provides an invaluable service in compiling information on foundation activity. No comparable service exists. Data presented in DATABOOK Section 3.E were derived by comparing entries in the Foundation Grants Index with the annual reports of foundations thought to be sponsors of educational KPU. Abstracts from the SSIE were also reviewed for the purpose of naming additional foundations and computing support obligations. Numerous discrepancies were found in grants and foundations included. Annual reports of the individual foundations are thought to be the best source.

Recommendations:

The Foundation Center has the capability to process all data submitted by foundations. A monitoring effort can rely on the Center's services if foundations are encouraged to provide accurate and current data to the Center.

More detailed information will result from the planned survey of institutional performers of educational RDDE to be contracted under NIE's R&D System Support Division.

DATA CRITIQUES AND RECOMMENDATIONS

DATABOOK CHAPTER: 3. SPONSORSHIP OF EDUCATIONAL RESEARCH AND DEVELOPMENT

SECTION: G. Coordination of Educational R&D

DATA SERIES REVIEWED:

Federal Interagency Committee on Education (FICE).

The Interagency Consortium of Federal Users of Educational Statistics.

Smithsonian Scientific Information Exchange (SSIE).

Name of data set or data series: Federal Interagency Committee on Education (FICE).

Source, availability, and documentation of data:

Membership consists of 30 Federal agencies and departments. The Committee is chaired by the Assistant Secretary for Education and receives administrative support from a small staff headed by the Executive Director, Bernard Michael. Information on the Committee can be obtained from Mr. Michael's office.

Approximately 14 subcommittees are active, not only conducting studies on which to base their recommendations, but also developing linkages with public and private organizations outside the Federal Government.

A subcommittee on Research, Development, Dissemination and Evaluation has recently been formed and is headed by NIE's Director, Harold Hodgkinson. The goals of this subcommittee are identified in the 1975 DATABOOK. Initial activity has focused on determining a domain for educational RDD&E.

Recommendations:

Cooperation between FICE and efforts to minitor KPU within NIE is critical in establishing an information system of optimum utility for the educational KPU system and ultimately, for education. FICE has a natural role in bridging the various agencies and departments participating in educational KPU and can greatly facilitate work undertaken by NIE to monitor the system. The subcommittee on RDDE may provide the proper base for a study to determine the focal tasks for educational KPU. This determination, incorporating many perspectives, will provide suggestions useful for the establishment of a task hierarchy. FICE does not have the staff capability or the resources necessary for conducting surveys.

8/15/75

NCES

PARTICIPATING AGENCIES - INTERAGENCY CONSORTIUM

ACTION

Civil Service Commission

Congressional Committees

Council of Economic Advisors

Department of Agriculture

Department of Commerce/Census Bureau

Department of Defense

Department of Health, Education and Welfare/Assistant Secretary for Planning and Evaluation

DHEW/National Institute of Education

DHEW/Office of Child Development

DHEW/Office of Civil Rights

DHEW/Office of Education

DHEW/Office of Education/FICE

DHEW/Public Health Service/Alcohol, Drug Abuse and Mental Health Administration

DHEW/PHS/National Center for Health Statistics

DHEW/PHS/National Institute of Health

DHEW/PHS/National Institute of Mental Health

DHEW/Social and Rehabilitation Service/National Center for Social Statistics

Department of Housing and Urban Development

Department of Interior/Bureau of Indian Affairs

Department of Justice

Department of Labor/Assistant Secretary for Planning, Evaluation and Research

Department of Labor/Bureau of Labor Statistics

Department of Transportation

Energy Research and Development Administration

Environmental Protection Agency

Equal Employment Opportunity Commission

Federal Trade Commission

General Accounting Office

Library of Congress/Congressional Research Service

National Aeronautics and Space Administration

National Endowment for the Arts

National Endowment for the Humanities

National Academy of Sciences

National Science Foundation

Smithsonian Institution

State Department

State Department/Agency for International Development

Veterans Administration

CONGRESSIONAL COMMITTEES PARTICIPATING IN INTERAGENCY CONSORTIUM

Senate Committee on Labor and Public Welfare

Senate Subcommittee on Education/Committee on Labor and Public Welfare

Senate Committee on Appropriations

House Committee on Education and Labor

House Subcommittee on Elementary and Secondary, Vocational Education/Committee on Education and Labor

House Select Committee on Education/Committee on Education and Labor

House Subcommittee on Labor-HEW/Committee on Appropriations

House Special Subcommittee on Education/Committee on Education and Labor

Senate Subcommittee on Labor-HEW/Committee on Appropriations

Senate Subcommittee on Handicapped/Committee on Labor and Public Welfare

Name of data set or data series: Smithsonian Scientific Information Exchange (SSIE)

SSIE maintains and constantly updates a data base of information on more than 200,000 ongoing and recently completed projects in basic and applied research in the life and physical sciences. Project information is gathered from over 1,300 different supporting Federal government agencies, state and local governments, nonprofit organizations, and colleges and universities. This information is indexed by a staff of scientists and engineers and entered into an in-house, computerized data base for storage and retrieval. The basic record in the SSIE system is the single page abstract of individual projects entitled "Notice of Research Project."

A computer search for projects related to educational KPU was commissioned by the NIE R&D System Support Division for the DATABOOK project. The search turned up approximately 6000 abstracts of which several hundred were eventually screened out.

Each notice includes the name of the sponsoring agency, title of the project, PI and department specialty, performing organization, period for the listing, and funds obligated for the appropriate fiscal year. The project abstract summarizes objectives of the study and its scope.

DATA CRITIQUES AND RECOMMENDATIONS

DATABOOK CHAPTER: 4. CONDUCT OF EDUCATIONAL RESEARCH AND DEVELOPMENT

SECTION: B. R&D Institutions

DATA SERIES REVIEWED:

Distribution of Awards to Institutions.

Institutions Receiving 6+ NIE Awards.

Producers of 50+ ERIC entries 1968; 1973.

Name of data set or data series: Distribution of Awards to Institutions

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Source, availability, and documentation of data:

Data for 1965 - 1968 is available from OE; data for 1973 - 1974 is available from Office of Budget, Planning, and Management.

Procedures of data collection:

Data collected by NIE is a by-product of funding decisions. Data are managed and analyzed by NIE's Data Management Office for 1972 to the present. Data prior to 1972 is maintained by OE. All awards by OE in 1965 - 1968 and all awards by NIE for 1973 and 1974 are included.

Major variables included:

Institutions conducting research and awards by agencies.

Reliability, validity, and utility of data for NIE monitoring:

The measures are as reliable as the internal data maintenance mechanisms and this is quite acceptable. The validity and utility of these data are contrained by the sample. Within this sample (OE or NIE awards) the measure is valid. It is also useful for internal OE or NIE decisions. For monitoring the distribution of awards among institution types for the whole KPU system this stands as a partial indicator.

Recommendations:

Until a comprehensive measure is taken, we cannot determine the representativeness of the OE and NIE award distribution. A comparison with the distribution of awards to institutions by other sponsors is recommended.

Name of data set or data series: **Institutions Receiving 6+ NIE Awards**

Source, availability, and documentation of data:

NIE, 1973-1974

Procedures of data collection:

Administrative data, continually available as by-product of funding decisions based on all NIE awards 1973/1974.

Major variables included:

Specific research institutions by number of projects awarded in two consecutive years.

Reliability, validity, and utility of data for NIE monitoring:

This measure is reliable and replicable. It is also a valid indicator of the distribution of NIE's awards. The utility of such a measure increases as a time series is built up. The data presented in this table are significant for internal NIE decision-making but cannot by itself be interpreted as representative of the KPU system.

Recommendations:

Extension of this measure to all other KPU sponsoring agencies is necessary to get a complete indicator. The difficulty of obtaining this data from other agencies increases as the activities of these agencies are not focused on educational KPU. Approaching from sponsors requires project level analyses. The alternative is to gather these data from institutions.

Name of data set or data series: Producers of 50+ ERIC entries 1968; 1973

Source, availability, and documentation of data:

ERIC, NIE (1967 - 1974)

Procedures of data collection:

Entries to the ERIC system are the solicited and unsolicited reports, papers, and articles screened by clearinghouse staffs and NIE's Reference Group. Tabulations presented in this table cover all such entries.

Major variables included:

Specific institutions by category - Federal Government, State and Local government, colleges and universities, other research organizations and professional associations.

Reliability, validity, and utility of data for NIE monitoring:

The reliability and validity of this measure are confounded by several factors. Reliability depends on the consistency of criteria exercised in admitting entries. While the content validity of this table is unquestionable, construct validity is not as certain. The growth reported between 1968 and 1973 may be a reflection of the growth of ERIC rather than KPU.

Recommendations:

A comparison of institutional producers recorded in ERIC and those contributing other published documents (e.g., books, journal articles) is necessary to validate this measure. The quality of product rather than the quantity is also a more desirable measure.

DATA CRITIQUES AND RECOMMENDATIONS

DATABOOK CHAPTER: 4. CONDUCT OF EDUCATIONAL RESEARCH AND DEVELOPMENT

SECTION: C. R&D Personnel

DATA SERIES REVIEWED:

National Register of Educational Researchers.

RESEARCH CENTERS DIRECTORY, 4th edition - "New Research Centers."

Membership in Professional Associations

AERA membership study.

American Psychological Association Manpower Studies, 1972; 1974.

Census of Population: 1970. OCCUPATION BY INDUSTRY

1972 SCIENTIST AND ENGINEER POPULATION REDEFINED, Volume 1, Demographic, Educational and Professional Characteristics.

Curriculum Information Center District Level Administrators by State and Job Function.

Education Directory: State Governments 1971-1972.

Doctorates Awarded and Education Doctorates by R&D Activity.

Name of data set or data series: National Register of Educational Researchers

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Source, availability, and documentation of data:

Study conducted by Ohio State University for Phi Delta Kappa in 1964 - 1965. Published as a book in 1966.

Procedures of data collection:

A one-time survey of educational researchers. An attempt was made to complete a comprehensive list of educational researchers which resulted in 17,000 names of which 70% were locatable. Questionnaires were mailed to them and 57%, or 6,800, responded. Of these, 800 were screened out as inappropriate. Subsequent analyses were based on the first 3,923 responses or 65% of the acceptable respondents.

Major variables included:

Sex, age, highest degree, major field of highest degree, major field of present professional identification, research area, present employment.

Reliability, validity, and utility of data for NIE monitoring:

These data were the best available on educational researchers. They certainly are not adequate now, ten years later. A comparable survey today might have fewer difficulties in contacting researchers and we can accept the premise that unlocatable researchers cannot be conducting much research. These data are a useful baseline but must be up-dated.

Recommendations:

A new procedure for data collection and maintenance is suggested at the conclusion of this section.

Name of data set or data series: RESEARCH CENTERS DIRECTORY, 4th edition - "New Research Centers"

Source, availability, and documentation of data:

The RESEARCH CENTERS DIRECTORY and the periodic supplements "New Research Centers" were edited by A. M. Palmer for the Gale Research Company. The 4th edition was published in 1972. A 5th edition has been published since these analyses were completed.

Procedures of data collection:

Information presented in the Directory was obtained directly from the head or a responsible official of the organization or its parent institution and in some instances, has been supplemented from documentary material or secondary sources.

Information presented in the DATABOOK on R&D personnel was computed from the individual entries under the Education section of the subject listings in the DIRECTORY and the supplements.

Major variables included:

University related and independently operated non-profit research institutions are 1) listed alphabetically, 2) grouped by sponsoring institutions listed alphabetically, and 3) listed by subject or principal fields of research activities. Each listing includes name, address, director's name, date of establishment, sources of support, staff, dollar volume of research, principal fields of research, facilities, media used for publication, and other activities engaged in.

Reliability, validity, and utility of data for NIE monitoring:

The entries are updated in the "New Research Centers" between editions of the DIRECTORY in an attempt to keep information about research current. This cannot be done for all research institutions. In computing personnel statistics we found inconsistent categories and missing data.

Recommendations:

Name of data set or data series: **Membership in Professional Associations**

Source, availability, and documentation of data:

These data were taken from the most recent membership rosters of AERA (1974), APA (1973) and ASA (1973) as of June 1975. Membership surveys are being conducted by AERA and APA, no such studies are planned for ASA.

Procedures of data collection:

Tables were approximated for each association or division.

Major variables included:

No quantitative variables

Reliability, validity, and utility of data for NIE monitoring:

Membership in these organizations does not signify an educational "R&D" worker, thus weakening the construct validity of these data. No conclusive totals should be drawn as double membership is frequent. The intersection of APA and AERA membership will be determinable from the AERA membership survey.

Recommendations:

Refer to studies being conducted by AERA and APA on membership.

Name of data set or data series: AERA membership study

Source, availability, and documentation of data:

The American Educational Research Association. Data collection and analyses not complete as of October 1975. Preliminary findings are available, report on the whole sample due within a year. Contact Ms. Stivers or Ms. Richardson, AERA 202 / 223-9485.

Procedures of data collection:

Questions included as part of membership forms. Therefore, total AERA membership will be surveyed. 1975 membership is close to 12,000. The information can be updated with new membership.

Major variables included:

Individuals will provide information on their institutional affiliation, title, organizations, degree and area of specialization, ethnic identity, sex, race, and age, their job responsibilities as well as principal and secondary disciplines.

Reliability, validity, and utility of data for NIE monitoring:

These data are extremely useful in describing the membership of AERA. The set of AERA members, however, is only partially isomorphic with total KPU personnel. Cross tabulation of members involved in R&D work with the other characteristics will provide more up-to-date information than is available elsewhere.

Recommendations:

These cross tabulations may not be undertaken by AERA without some prompting. This is certainly a recommended first step in measuring the R&D workforce, though AERA does not embrace the entire personnel population.

Name of data set or data series: American Psychological Association Manpower Studies, 1972; 1974.

Source, availability, and documentation of data:

APA Clearinghouse for Information on Psychology's Manpower. Manpower studies from data collected in 1972, information available on data currently being analyzed. Contact: Janet Cuca, APA, 1200 17th Street NW, Washington, D.C.

Procedures of data collection:

The 1972 questionnaire was mailed to APA members (35,361) plus other known psychologists. Response rate of members = 77%. Analyses based on these 27,371 responses and the responses from 7,990 non-members. A sub-study on 12,554 members employed in higher education is most relevant to Educational KPU Monitoring. Data analysis for the 1974 study is still underway. The questionnaire is available for both studies, 1972; 1974.

Major variables included:

Sex, degree, APA Division (Educational Psychology = 2,156, School Psychology = 2,819, both together = 16.4% of the sample for the 1972 general study), age, geographic location, major field of highest degree, awards, first and second scientific specialty, employment, ethnic/racial identity, publications, support sources, etc.

Reliability, validity, and utility of data for NIE monitoring:

These studies provide stable measurement of a changing sample and should be reliable over time. The detail of questions results in unambiguous responses. There is no reason to question the content or construct validity of the measures, but it is important to keep in mind that psychologists rather than educational R&D or KPU personnel are being studied. This limits the utility of these data for NIE monitoring.

Recommendations:

Arrangements can be made with APA to do crosstabs for psychologists in the educational and school psychology divisions with the other variables.

Name of data set or data series: Census of Population: 1970
OCCUPATION BY INDUSTRY

Source, availability, and documentation of data:

U.S. Bureau of the Census, Census of Population, 1970. OCCUPATION BY INDUSTRY. Final Report PC (2)-7C, U.S. Government Printing Office.

Procedures of data collection:

A 20% sample of the total employed population sixteen years old and over. The results are then blown up as an estimate of the total population.

Major variables included:

Within a detailed occupation scheme it was possible to isolate educational R&D personnel in the following categories: Social Scientists in elementary and secondary schools = 193 (not counting 6,660 Psychologists); research workers in elementary and secondary schools = 983; research workers in educational services = 581.

Reliability, validity, and utility of data for NIE monitoring:

These data give an estimate for local R&D personnel related to KPU. They do not cover R&D workers employed in higher education as it was impossible to disassociate educational researchers from researchers in other fields. These figures provide a bare minimum from which NIE can estimate R&D personnel in the schools.

Recommendations:

Name of data set or data series: 1972 SCIENTIST AND ENGINEER POPULATION REDEFINED, Volume 1, Demographic, Educational and Professional Characteristics

Source, availability, and documentation of data:

NSF, Division of Science Resources Studies. Additional reports are soon to be released. Raw data and tabulations are accessible to NIE staff.

Procedures of data collection:

These data are based on a national sample of over 100,000 persons in the 1972 Professional, Technical and Manpower Survey conducted by the Bureau of the Census for NSF. A 20% sample of relevant occupational groups was selected on the basis of response to the question, "What kind of work was he doing?"

Major variables included:

Fields of science and engineering, age, sex, level of educational attainment, fields of study, professional society membership, career entry jobs, place of residence. Educational researchers are not deliberately included unless their work is related to fields of science or engineering. "Psychology" and "Sociology" are considered "scientific" disciplines whereas "Education" is not.

Reliability, validity, and utility of data for NIE monitoring:

These data are as reliable as the census measures. The utility of these data is limited for NIE as it is not possible to identify educational R&D personnel. They do present the background on scientific workers against which educational R&D personnel can be compared.

Recommendations:

Use of census data is not generally recommended for NIE. The educational R&D population is too small to warrant searching census data bases less highly aggregated. Available data from the Census of Population, Occupation by Industry, 1970 is reviewed on the following page.

Name of data set or data series: Curriculum Information Center
District Level Administrators by State
and Job Function

Source, availability, and documentation of data:

Curriculum Information Center is a private, for-profit marketing concern. Information is available from them at a cost. (Ms. Jean Hayes, East Coast Representative, Curriculum Development Center, Brooks, Towers, Suite 42-C, 1020 15th Street, Denver, Colorad 80202.)

Procedures of data collection:

Information is collected by CIC via telephone survey for every school district in the country. These data are frequently updated. The figures presented in the DATABOOK are the result of Winter 1974 survey. Another survey is currently underway.

Major variables included:

Name, institution and position of district level and state level education personnel. The positions of direct relevance to R&D are Testing and Research and Development. Dissemination personnel are included in the category "public information" and cannot be separated out.

Reliability, validity, and utility of data for NIE monitoring:

These data do not claim to present a complete listing of personnel. CIC is interested in the names of decision makers that others will want to contact. Therefore, low-level personnel generally will not be covered. Lists from CIC may be useful for rough estimates of personnel or contracts.

Recommendations:

Name of data set or data series: Education Directory: State Governments 1971-1972 (not included in DATABOOK)

Source, availability, and documentation of data:

List of personnel positions in State Departments of Education. Although this is supposed to be an annual publication, it was last published in August of 1971. As the title suggests, it was intended to reflect department personnel for 1971-1973. It is out of print.

Procedures of data collection:

Lists of personnel positions and individuals filling them were collected from the State Departments of Education.

Major variables included:

No quantitative variables.

Reliability, validity, and utility of data for NIE monitoring:

The number of R&D personnel working at State Education Departments was impossible to estimate from this source. The titles of positions were ambiguous in many agencies. No distinctions were drawn between part time and full time positions.

Recommendations:

Do not use this source.

Name of data set or data series: Doctorates Awarded and Education Doctorates by R&D Activity

Source, availability, and documentation of data:

Raw and summary data on doctorate recipients from U.S. universities are maintained by the National Research Council, National Academy of Sciences. Some of these series extend back to 1920. Data manipulations will be undertaken by NRC for a small fee. (Contact: Muriel Quinones 202 / 389-6739)

Procedures of data collection:

Information used in these data series is required of students applying for their doctorates. It is therefore coverage of the subject pool. Individuals working in educational R&D in the U.S. who received doctorates elsewhere are not included.

Major variables included:

Data on doctorate recipients are disaggregated by sex, race/ethnic group, age, major, undergraduate degree, marital status, primary activity, secondary activity (1972, 1973), source of support, granting institution, state, post-doctoral employment, area of specialization. This last data set is particularly useful in determining which Ph.D.s in Psychology, Sociology, Economics are concerned with Education.

Reliability, validity, and utility of data for NIE monitoring:

These data provide a reliable indicator of the U.S. Doctorates. The addition of secondary activity from 1972 on will provide a better estimate of the professionally qualified educational R&D workforce. Whether or not the individuals are actually engaged in educational R&D in employment cannot be determined from these series. These data do not cover persons without Ph.D.s, thus excluding junior researchers, students and support staff.

Recommendations:

Doctorate recipients whose expected primary or secondary work activity is educational R&D could serve as subjects for a longitudinal or follow-up study on R&D personnel. At the present time we have little information on the utilization of a doctorate in educational research. Judging by this table a majority of the researchers in education do not have their highest degrees in education. While there are several possible methods for determining why this is so, a follow-up study on doctorate recipients can also help shed light on this issue.

PERSONNEL RECOMMENDATIONS

The current KPU workforce has not been adequately measured. DATABOOK attempts to triangulate on an updated estimate for personnel by presenting data from several sources that partition the universe in different ways.

Estimates of the population are made by extrapolating from studies conducted in the 1960's. In view of the growth of educational research activities over the past decade one would suspect large increases in the personnel employed.

A second approach to estimating R&D personnel has been to tabulate the number of individuals participating in educational R&D activities. An attempt was made to locate personnel through work institutions. Figures were calculated for the government employees, local school employees, and the researchers in non-profit and university affiliated research institutions. However, it was not possible to complete the set or to determine the amount of double counting. Estimates were also derived from membership in relevant associations and authorship data. The third line of investigation analyzed the potential pool of senior educational R&D personnel from data on doctorate recipients.

None of these measures embraced the total population, nor did they identify a representative sample. This would seem to suggest that a comprehensive study be undertaken in the near future to provide a much needed indicator of KPU personnel.

The National Center for Educational Statistics decided against doing a study of RDDE personnel for NIE two years ago. According to staff of the NCES Educational Manpower Statistics Branch, two main factors influenced their decision. First, the pool of educational RDDE personnel is very difficult to measure. People can be drawn into educational KPU from many fields -- Psychology, Sociology, Engineering, Economics, Anthropology, etc. The composition of the employed workforce continually changes as individuals begin or complete educational RDDE projects. Therefore, a study could not describe the pool of potential KPU personnel without including members of numerous disciplines. The resulting figures would then be too rough to be useful.

Second, NCES staff did not see the need for precise measurement of KPU personnel. They did not think policy implications of 6000 versus 8000 researchers were significant.

These arguments suggest that before measurement of KPU personpower is undertaken, we must reconsider the role for personnel statistics in monitoring KPU. Thus far indicators for personnel have attempted to measure the number of individuals (or full-time equivalents)

involved in R&D and some of their characteristics. Even if these data were available we might not have the knowledge on which to base policy decisions. Questions concerning the tasks researchers are focused on, how well they have performed in the past or what they are interested in and capable of doing, have not been asked. Yet this is equally important information for monitoring and improving the KPU system.

There are several possible strategies for acquiring data on personnel. The least expensive approach relies on data collection by others. Further analysis of the manpower data gathered by APA or the membership data collected by AERA would be modest in cost and illuminating. Such analyses would not describe the personnel universe for KPU or ask many of the questions most relevant to monitoring KPU. However, this approach is recommended as an immediate solution.

A second strategy is to replicate one-shot studies such as the survey conducted by Ohio State University for Phi Delta Kappa in 1964-1966, or to design a new study that measures alternative or additional variables.

The utility for monitoring KPU of any one time survey of personnel is questionable. Assuming optimal and unlikely conditions (a high proportion of personnel can be located, and a high response rate is achieved) the changing composition of the workforce and the changing demands of the system would result in statistics too quickly obsolete. As no evidence dictates a reasonable way to sample this population, a census would be necessary and costly. A similar survey would be required periodically to provide time series data.

An alternative to replication studies is the creation of a continually updated computer file on personnel. NIE currently maintains a a file of NIE grant applicants and a file of NIE award recipients. These files cover only a small percent of all individuals in the KPU personnel pool. Although much useful information can be gleaned from the internal data management system, coverage of the employable educational KPU pool is needed.

Our review of studies has consistently revealed differences between the rate of response to questionnaires that are required as part of another focal procedure and surveys relying upon voluntary participation. Thus association studies that collect data as part of membership renewal and special analyses of required budget information are based on high response rates. In contrast, the personnel census undertaken by Ohio State University in 1964 could not even locate 29% of identified possible educational researchers. Only 56% of the individuals contacted actually returned the questionnaires.

These response rate differences are to be expected and monitoring activities of NIE must be planned to elicit a strong response. This is most probable if NIE can enlist the cooperation of other Federal agencies and outside institutions for data collection. We recommend that NIE develop a very brief form to collect information on the primary and

and secondary areas of research interest, current activities, background, qualifications and expertise of KPU personnel. Completion of this form by all applicants for funding in the field of educational KPU would be desirable. The coordination of this effort would be facilitated with the assistance of the Federal Interagency Committee on Education or its recently formed subcommittee on RDD&E. Data would be coded, filed, analyzed, and maintained on line by NIE. Continual updating would provide NIE with current report on who is conducting educational RDD&E, who is capable to direct new projects and which areas of research expertise are inadequately represented, thus signalling the need for training programs.

Comprehensive data collection from institutions or individuals outside the givernment may be difficult unless an incentive is offered. Survey researchers frequently encourage response by offering a small ($.50) inducement for participation. Rather than offer a direct monetary reward NIE can draw on its information resources. Associating the data collection form with a mailing list for RFP announcements or ERIC reports targeted at the researcher's primary and secondary areas of interest might stimulate the desired response.

DATA CRITIQUES AND RECOMMENDATIONS

DATABOOK CHAPTER: 4. CONDUCT OF EDUCATIONAL RESEARCH AND DEVELOPMENT

SECTION: D. R&D Activities and Products

DATA SERIES REVIEWED:

Primary Subject Areas of 661 NIE-Sponsored Products: 1975

ALERT: A Sourcebook of Elementary Curricula Programs and Projects. Samuel Henrie, (Ed.).

Authorship of educational research articles and convention papers.

Name of data set or data series: Primary Subject Areas of 661 NIE-Sponsored Products: 1975

Source, availability, and documentation of data:

A CATALOG OF NIE EDUCATION PRODUCTS will be published in Winter 1976. Raw data and tabulations are available for further analysis.

Procedures of data collection:

Guidelines and questionnaires were sent to 23 labs and R&D centers, the 16 ERIC Clearinghouses and 521 other contractors and grantees. Response rate from labs and R&D centers was high: 700 products were reported on; 16 respondents were responsible for 500 products.

Major variables included:

Primary subject area, format, institutional origin, utilization history, evaluation status, sales data, dissemination and utilization costs, etc.

Reliability, validity, and utility of data for NIE monitoring:

The low response rate from developers other than labs and R&D centers biases the results of this study. Data presented on the 661 NIE products included are reliable for certain variables such as primary subject area, but cost and cost-benefit data are not stable. The difficulties encountered in data collection ought to be considered in planning future studies.

Recommendations:

Several reports have been written on the products of educational R&D. A review and analysis of these documents would improve the output indicators of R&D.

Name of data set or data series: ALERT: A Sourcebook of Elementary Curricula Programs and Projects. Samuel Henrie, (Ed.).

Source, availability, and documentation of data:

Far West Laboratory for Educational Research and Development, San Francisco, Ca., 1972. The Sourcebook contains extensive descriptions of curricula programs and products. The information is unaggregated.

Procedures of data collection:

A survey of hundreds of journals, conference reports, listings of grant awards, ERIC reports and personal contacts resulted in a data base (the educational development information file or EDIF) from which the highest quality innovations were selected for this source book by the editor.

Major variables included:

Each curricula or project is described in the appropriate subject matter section (e.g. aesthetic education, science eduation, etc.). Information is presented on target audience, content emphasis, developer, distributor, topics, student goals, use, testing, evaluation, availability, etc.

Reliability, validity, and utility of data for NIE monitoring:

The criteria for selection of programs to be included in the Sourcebook were as follows:

1. First priority - programs produced by research and development agencies (agencies that establish performance objectives, field test and revise programs);
2. Second priority - new non-RUD programs that have demonstrated their value through field trials;
3. Third priority - other new programs that have not been rigorously evaluated, but show internal evidence of good quality and represent important alternatives to traditional practice.

No data are given on the percent of programs qualifying under each category, nor is there information on inter-coder reliability. To our knowledge no formal evaluation of the ALERT Sourcebook has been conducted but it has been field tested and revised by the Far West Laboratory.

Recommendations:

The utility of this sourcebook and several other studies on the products of educational research and development would be increased by a thorough review and interpretation of these products.

Name of data set or data series: Authorship of educational research articles and convention papers

Source, availability, and documentation of data:

Tabulations and summary are contained in a report by Caroline Persell, "The Quality of Research on Education: An Empirical Study of Researchers and Their Work," Columbia University, Bureau of Applied Social Research, 1971.

Procedures of data collection:

A questionnaire addressed to authors of articles and convention papers dealt with training and professional background, the context in which the research was done, career activities, field and specialties, productivity, etc. Additionally, 400 articles and papers were submitted to 40 judges for quality ratings.

Major variables included:

Professional demography of authors, topics of articles and papers, quality ratings.

Reliability, validity, and utility of data for NIE monitoring:

A study like this can be used in a multiple-measurement framework to reflect upon the contexts and topics of educational research. The classification of topics of educational R&D always presents reliability and validity problems. The measurement of quality, a unique aspect of this study relative to other studies of educational R&D articles and papers, is an interesting exercise in peer judgment but of limited utility lacking norms across times and topics.

Recommendations:

A study like this should be incorporated in the NIE monitoring system whenever an investigator like Persell happens to do it. However, it cannot be a programmed component of the monitoring system without preconsidered sampling of the entire educational R&D literature (perhaps of a given year), including books and technical reports. Using the questionnaire approach, NIE can obtain certain variables from authors that cannot be computer-analyzed from the ERIC bibliographic data base, but cost of the questionnaire study may exceed utility of those variables in the monitoring system.

DATA CRITIQUES AND RECOMMENDATIONS

DATABOOK CHAPTER: 5. DISSEMINATION OF EDUCATIONAL RESEARCH AND DEVELOPMENT PRODUCTS AND INFORMATION

SECTION: B. Federal Network

DATA SERIES REVIEWED:

ERIC Bibliographic Data.

Name of data set or data series: ERIC Bibliographic Data

Source, availability, and documentation of data:

The ERIC bibliographic data base is available in machine-readable form (tape) from the current contractor operating the "ERIC Facility" for NIE (contractors change periodically; the right to distribute ERIC tapes is then transferred to the new contractor). ERIC tape documentation available from contractor and NIE.

Procedures of data collection:

ERIC bibliographic data is first compiled in ERIC clearinghouses and the ERIC facility. It is keyboarded for typesetting Resources in Education and Current Index to Journals in Education. It then becomes available for computer searching (in its intended bibliographic use) and computer analysis (in its "unintended" use as a data base descriptive of educational R&D activity).

Because of decentralized acquisition of documents and journal articles at subject-specific clearinghouses, coverage of educational R&D literature in ERIC is very broad. Literature descriptive of trends in educational practice is also, at least for analysis purposes, fully covered.

Major variables included:

Authorship of educational literature: aggregatable into number of authors as a reflection on workforce in R&D and practice sectors that contributes to this KPU data base. Affiliations of authors: aggregatable into institutional totals. Topics of documents and articles. Year of publication or release. Pagination. Free text of abstract contains additional information about project histories and outcomes, cooperative arrangements, student populations involved, etc.

Reliability, validity, and utility of data for NIE monitoring:

These data have a desirable "unobtrusive" quality. Taken in the aggregate and computer-analyzed through the ERIC bibligraphic data base, the educational R&D and practice literature reflects activities in R&D and practice that are difficult to observe and summarize otherwise. Although ERIC covers educational literature quite well, a multiple-measurement approach including direct measures is advisable to bridge inference from educational literature to educational activity.

Recommendations:

Time-series analyses should be completed of author, institution, and topic variables by years. Rank-ordered displays of institutions and topics by years has descriptive value. A brief manual for ERIC analysis should be prepared, detailing strengths and weaknesses of the data base relative to reliability, internal validity, and external validity.

DATA CRITIQUES AND RECOMMENDATIONS

DATABOOK CHAPTER: 5 DISSEMINATION OF EDUCATIONAL RESEARCH AND DEVELOPMENT PRODUCTS AND INFORMATION

SECTION: D. Other Dissemination Programs

DATA SERIES REVIEWED:

Educational Information Resources.

Name of data set or data series: **Educational Information Resources**

Source, availability, and documentation of data:

Study conducted by System Development Corporation (Santa Monica, CA) under contract to the National Center for Educational Communication, OE, in 1970.

Published as DIRECTORY OF EDUCATIONAL INFORMATION RESOURCES in 1971 by CCM Information Corporation (New York), Judith Wanger, compiler.

Procedures of data collection:

Existing lists of educational information programs and centers were supplemented by fresh questionnaire data. A census of educational information resources across all U.S. states and territories was attempted. However, most proprietary information resources were excluded (e.g., proprietary computer on-line search services).

Major variables included:

Each program or center constitutes an entry in the directory. Some of these resources are considered central, others peripheral. Peripheral resources (e.g., educational R&D centers, regional laboratories) are noted in passing only, with address and telephone number. For each central resource, data on objectives, staffing, service area, etc., are provided, together with the name of a contact person. Directory is organized by state and city.

Reliability, validity, and utility of data for NIE monitoring:

This kind of census is susceptible to omissions either by definition or by oversight during the data collection. For example, no teacher centers are included. In fact, the definition of "educational information resource" as a library-like program or center led to the omission of information resources ranging from technical assistance programs to educational broadcasting for educators. However, RVU of included data are acceptable as 1970 baseline.

Recommendations:

A low-cost mechanism is needed for annual updating of a directory of this kind. Programs and centers are established and disestablished with great frequency, but the number and distribution of these resources across the U.S. are important planning data for NIE.

DATA CRITIQUES AND RECOMMENDATIONS

DATABOOK CHAPTER: 6. UTILIZATION OF EDUCATIONAL RESEARCH AND DEVELOPMENT PRODUCTS

SECTION: B. Utilization Related to General Educational Improvement

DATA SERIES REVIEWED:

Selected innovations in U.S. school districts.

Adoption of innovations in urban secondary schools.

Name of data set or data series: Selected innovations in U.S. school districts.

Source, availability, and documentation of data:

Havelock, R.G. and Havelock, M.C. EDUCATIONAL INNOVATION IN THE UNITED STATES, Volume 1: The National Survey: The Substance and the Process. Center for Research on Utilization of Scientific Knowledge (CRUSK), University of Michigan, 1973.

Procedures of data collection:

A questionnaire was sent to a probability sample of 500 school district superintendents. Tables are based on the responses of 353 districts (71%). No systematic differences in response rate by district enrollment size or region were apparent. Twelve non-respondents said they had no memory of innovations. Of the 353 respondents 98% reported at least one innovation. The study was conducted in 1971-1972.

Major variables included:

Innovations defined as "A major change introduced in the last year for the purpose of improving the quality of education within your district. This change may have involved any of the following:

a. a substantial reorientation on the part of staff,
b. a reallocation of resources,
c. adoption of new practices, programs or technology."

Districts categorized by enrollment size and region were questioned about the nature, introduction, implementation, personnel and consequences of major and minor innovations.

Reliability, validity, and utility of data for NIE monitoring:

This study represents a positive step in monitoring educational KPU. The survey was inexpensive (under $100,000) and found evidence to support or refute several competing models of change in education. The researchers found a plentitude of innovations but an inadequate flow of information concerning factors affecting the success or failure of innovations in particular settings.

Recommendations:

It was not possible to measure the rate of success school districts had in innovating due to the reluctance of superintendents to discuss failures. Information which accounts for success or failure is useful for improving the system. The dissemination of this information is not a monitoring task but reports on the amount of dissemination and the success rates for innovations are tasks for a monitoring system.

Name of data set or data series: Adoption of innovations in urban secondary schools

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Source, availability, and documentation of data:

Tabulations and summary are contained in a report by Margaret Nelson and Sam Sieber, "Innovations in Urban Secondary Schools," Columbia University, Bureau of Applied Social Research, 1975. Original data set was described by Havighurst, Smith, and Wilder, "A Profile of the Large-City School," Bulletin of the NASSP, 1971, 25, 11-13.

Procedures of data collection:

This study is based on a secondary analysis of data collected in 1969 by Robert J. Havighurst for the National Association of Secondary School Principals. The survey was conducted among all secondary school principals of 670 schools in U.S. cities with population over 300,000. Questionnaire response rate was 82%. In addition to questionnaire data from the secondary schools, a panel of experts was asked to characterize each of 17 innovations according to quality, administrative difficulty of implementation, and durability.

Major variables included:

Extent of adoption was the chief dependent variable. The chief independent variables were quality, administrative difficulty of implementation, durability, and cost. A typology of schools was constructed from data on extent of adoption and quality of innovations adopted ("backward," "faddist," "selective," and "pacesetter"). Analysis of the data is analytical rather than descriptive; large frequency displays are not included.

Reliability, validity, and utility of data for NIE monitoring:

Since the study is analytical rather than descriptive, it has to be judged for its analysis of "why" rather than "how much" adoption or "where." The independent variables are unique in this kind of diffusion study insofar as they all relate to characteristics of innovations, not characteristics of innovators or settings. Whereas relationships among cost, durability, quality, extent of adoption are interesting, a psycho-sociological dimension is missing.

Recommendations:

It would seem beyond the capacity and aspiration of a monitoring system to sort out the various and often conflicting interpretations of why change occurs in education. For example, Richard Carlson's interpretation of the adoption of educational innovations (in his book of that title) stresses characteristics of the innovator and the adoption setting. Who is more nearly right -- Nelson-Sieber or Carlson? Actually both studies contribute to a plausible multivariate interpretation.

The NIE monitoring system can deal with these analytical rather than descriptive studies in four ways: (1) define them outside the scope of monitoring; (2) commission or at least collect occasional benchmark reviews of the "what causes educational change?" literature; (3) collect all sound studies as important although difficult to integrate with descriptive monitoring; (4) collect all sound studies that display at least one interesting descriptive fact (e.g., adoption of 17 innovations in 670 schools) and ignore analytical objectives of the author(s).

DATA CRITIQUES AND RECOMMENDATIONS

DATABOOK CHAPTER: 6. UTILIZATION OF EDUCATIONAL RESEARCH AND DEVELOPMENT PRODUCTS

SECTION: C. Utilization Related to Specific R&D Products

DATA SERIES REVIEWED:

Far West Lab case studies of diffusion of R&D-based educational programs and products.

Name of data set or data series: Far West Lab case studies of diffusion of R&D-based educational programs and products

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Source, availability, and documentation of data:

Case studies of diverse educational innovations, ranging in target group from preschool to higher education, are contained in a report by Brenda Turnbull et al., Promoting Change in Schools: A Diffusion Casebook, Far West Laboratory for Educational Research and Development, 1974.

Procedures of data collection:

Information on product development, evaluation, dissemination and/or marketing, and utilization was gathered from product developers, marketers, etc.

Major variables included:

Objectives of products, development histories, rationales, content descriptions, evaluation outcomes, dissemination/marketing histories, utilization histories, extent of adoption/sales figures.

Reliability, validity, and utility of data for NIE monitoring:

These are unquestionably reliable reconstructions of the development, dissemination/marketing, and utilization of the selected programs and products, from the developers' perspective. The validity of the reconstructions from the perspective of users is unknown. Presumably the extent of adoption/sales figures reflect users' opinions of the merit of the programs and products.

Recommendations:

Although case study data are not parametric, they are useful to the monitoring system because they describe a normal flow of events from R&D tasks through evaluation, dissemination/marketing, and utilization. This flow might be characterized as longitudinal; by contrast certain sample surveys (e.g., Havelock and Havelock, 1973) are latitudinal, in that they describe a larger set of products in more adoption settings but without detail on the histories of the products before and after the cross-section of time studied.

6. RECOMMENDATIONS

Underlying the following recommendations for NIE's KPU monitoring program are the numerous difficulties encountered in compiling the DATABOOK from many of the same data sources that must be used in any feasible monitoring program. What is recommended is not an idealized monitoring program, for several reasons:

1. An idealized program is possible only if no compromises are made in the definition of data series, samples chosen, and timing of data collection. An idealized program is possible only if NIE assumes primary responsibility for all monitoring procedures; this would involve near-duplication of monitoring efforts in other agencies.

2. Despite its limitations, the 1975 DATABOOK provides a number of baseline measures that the monitoring program can build upon. Although such measures could be defined more elegantly in an idealized program, loss of comparability with the 1975 DATABOOK baselines is a high price to pay.

3. An idealized program calls for over-definition of data series, relative to NIE's present procedures for collecting primary data or adapting secondary data. Older agencies and those with routinized programs (e.g., Agriculture, Veterans Administration) may expect to need almost exactly the same monitoring data over a number of years, whereas NIE may find that its needs for monitoring data change almost yearly. The elegance and rigor of an idealized program is incongruent with NIE's probable need to reformulate its monitoring requirements frequently.

These recommendations, therefore, point toward a monitoring program that emphasizes heuristic rather than deterministic procedures. Stated most simply, the purpose of NIE's monitoring program is to reduce uncertainty in policy formulation. "Uncertainty reduction" is a technical concept of the information theorists, who are concerned about the minimum number of bits of information input that will differentiate alternatives in the decision output. In the view of information theorists, a preferred data base reduces uncertainty to a criterion level at minimum information cost, considerations of elegance and rigor aside.

Certain recommendations are notable in their absence from the following list. Just as we do not consider it feasible for NIE to assume the primary role in all data gathering related to educational KPU (point #1 above), neither do we consider it feasible for NIE to delegate all or most of the data gathering to other agencies, even those with strong general monitoring programs (e.g., NCES, NSF, and OMB). Rejecting the parallel alternatives of "Do it all in-house" and "Leave it all to other agencies" brings us by default to the complicated third alternative, "Collect in-house only data series that are ignored by other agencies or collected inadequately by them" (recommendation #7 below). What makes the third alternative complicated, of course, is an intermediate range of options to fix up or supplement the partially adequate data gathered by other agencies.

Another course of action not recommended for NIE is the commissioning of further studies on monitoring concepts and procedures per se. The interrelated studies of educational KPU commissioned in 1974 and now reaching final report stage are reasonably convergent in their independent views of significant KPU variables that can be monitored. It should now be the role of NIE staff and their advisers to choose which monitoring recommendations are to be accepted and to prioritize the monitoring of particular variables relative to support available for a monitoring program.

The recommendations below begin with a "strategic" set -- recommendations affecting the design of the monitoring program. These are followed by a "tactical" set -- recommendations affecting the implementation of monitoring procedures.

1. DEFINE THE SCOPE OF AN EDUCATIONAL KPU MONITORING PROGRAM STRICTLY WITH RESPECT TO: (a) THE CHOSEN MODEL OF EDUCATIONAL KPU STRUCTURE AND PROCESS; (b) THE AGENCY MISSIONS THAT THE PROGRAM INFORMS.

   We have shared with NIE staff the experience of gathering some data series, acquiring other data series from the monitoring programs of other agencies, fixing up and supplementing partially adequate data. These efforts are arduous and costly. It is better to have strong data on a small number of key indicators than weak data on all the "potentially interesting" indicators, of which in fact there are many.

   The chosen model of educational KPU structure and process serves to focus attention on key indicators. Agency missions -- the current programs of the agency and their reporting/assessment requirements -- not only sharpen the focus on key indicators but also determine how much precision, representativeness, and timeliness is justified, relative to cost, in the data series underlying each indicator.

   Heuristic and deterministic monitoring procedures part company on the "how much?" question. Deterministic procedures, such as those employed by the Bureau of the Census and (in most studies) by the National Center for Educational Statistics, strive for maximum reliability/validity and minimum error of estimate. Heuristic procedures make explicit the cost/utility function -- for example, in a given data series, 75 percent of the maximum/minimum levels can be obtained for 50 percent of the full cost. Whether 75 percent of the maximum/minimum levels will suffice depends on the agency missions that the data serve.

2. DEFINE A HIERARCHY OF EDUCATIONAL KPU TASKS AS MONITORING FOCI.

   It is more important to know what the system does (process) than what the system is (structure).

   A task focus theoretically can be applied to tasks at varying levels of specificity. Whether this is true in practical application must be tested.

Progress in educational KPU can best be measured if problems under attack are made explicit. The task orientation is natural to KPU activities. Research and development are expansions of what is currently knowable and producible. The primary step in research and development is the statement of the problem or task.

Task monitoring focuses on such questions as:

-- What are the manifest educational KPU tasks at a given time?

-- Which agencies, institutions, or individuals determine these tasks?

-- How are resources distributed among the tasks?

-- What role does directive and persuasive information play in the distribution of resources among tasks?

-- How successful is each component in dealing with its array of tasks?

-- Etc.

In EDUCATIONAL RESEARCH AND DEVELOPMENT IN THE UNITED STATES (1969), Gideonse reports on the project taxonomy his staff and he developed in the National Center for Educational Research and Development. Over an 18-month development period, six dimensions were used in the taxonomy to classify R&D projects. Even in its third iteration the taxonomy was difficult to work with. Projects (i.e., operationalized task statements) often fell between or across dimensions of the taxonomy. Development of a KPU task hierarchy will be as difficult to accomplish if comparable detail is sought.

At higher levels of the hierarchy, tasks may be stated in accord with educational KPU legislation, executive orders, and agency policy statements. Key terms for higher levels of the hierarchy are embedded in these source documents as educational deficits (e.g., inadequate preparation for the world of work), educational opportunities (e.g., new applications of instructional technology), target student groups (e.g., preschool, culturally disadvantaged, physically handicapped), and other dimensions along which educational improvement is approached.

Middle levels of the hierarchy can be informed by program-level descriptions of educational KPU missions; by the conceptual work of policymakers, researchers, developers, etc.; and by the views of the larger community concerned with educational KPU.

Lower levels of the hierarchy should correspond to project-level descriptions of agency activity and to the tasks that researchers and developers say they are addressing. After key terms have been derived from these sources, some middle-level categories in the hierarchy will be found to have no subordinate categories at lower levels. These are gaps in the overall educational KPU agenda; terms can be assigned to these gaps as placeholders while alternative forms of "gap-filling" research and development are considered.

Thus the task hierarchy describes at several levels of abstraction which educational KPU tasks the attention of policymarkers, researchers, developers, and others is fixed upon. The task hierarchy emphasizes process rather than structure in the KPU enterprise, since structural monitoring (e.g., there are 500 educational R&D institutions and 10,000 educational R&D personnel) evokes a "so what?" response from observers concerned only with educational KPU accomplishment.

Structural variables are monitored within rather than across task categories. It is germane to know how many R&D institutions and personnel are working on each task (e.g., the improvement of career education). It is less germane to know these structural variables at high levels of abstraction.

3. MONITOR FLOWS BETWEEN COMPONENTS OF THE EDUCATIONAL KPU SYSTEM.

In addition to tasks performed within each component, it is important to monitor the flow of money and information between components. Systemic coherence derives from these flows.

The model developed in this report and the indicators derived from it emphasize the importance of flows between components. Distinguishing between money flows and information flows, we have categorized information into: 1) products of the KPU process; 2) directives for future KPU activities; and 3) persuasive information which influences the KPU process. In prior models of KPU the directive and persuasive flows have been neglected. The result of this neglect has been a gap between the modelmaker's conceptualization and the policymaker's reality.

In recent years the flow of information between components has steadily increased. Although we do not have statistical documentation of this growth, there is evidence to be found in Federal legislation and programs, State legislation and local activities.

Increased Federal funding of R&D over the past decade has been accompanied by an ever greater flow of directives from the Federal government to the R&D component, to the Diffusion and Dissemination component, and to the School component. The institutionalization of the Diffusion and Dissemination component is recognition of the need to facilitate the flow of information products from the R&D component to the schools.

Federal mandates for evaluation and assessment (e.g., ESEA Title I and Title III) have established a flow of information from the School component through the State departments of education back to the Federal government. Although classified at origin as product information, these evaluation/assessment reports have been used persuasively to encourage continued funding and directively to indicate which tasks require greater effort.

The flow of directive information from the public to the schools (parent involvement programs) and to the decisionmakers (citizen advisory boards) is still developing (ETS, 1973b).

There is growing realization that each component of the educational KPU system contributes to the success or failure of tasks performed in other components and that intercomponent effects can be gauged by flows that are occurring.

4. INSOFAR AS REQUIRED BY POLICY, MONITOR CAPACITY AND GROWTH OF THE EDUCATIONAL KPU SYSTEM.

   The most important indicators on the side of system structure are those that reflect on the system's capacity to perform at the present time and its probable future growth.

   Assuming that KPU institutions and personnel are the key factors in system capacity (funding, the third key factor, being subject to feast-and-famine cycles), it may be that elasticity in institutional and personnel resources is more important in gauging capacity than the actual strength of either at a given time.

5. (Corollary to #4) TO BRIDGE A MAJOR GAP IN KNOWLEDGE OF THE EDUCATIONAL KPU SYSTEM, DEVISE PROCEDURES FOR MONITORING PERSONNEL CAPACITY AND GROWTH RELATIVE TO EACH KPU ROLE.

   The current KPU workforce has not been adequately measured, particularly with respect to emerging KPU roles in evaluation, dissemination, planning, etc. The 1975 DATABOOK attempts to triangulate on a current estimate of personnel in research and development roles, but little can be said about personnel in other roles.

   Procedures for estimating personnel by role and task can be derived from the experience of other agencies -- for example, NSF's National Register of Scientific and Technical Personnel.

However, much of the difficulty in measuring the educational KPU workforce arises in self-definition of activity. Personnel who perform KPU functions often define their activities in terms of pre-KPU labels.

6. (Corollary to #4) TO BRIDGE ANOTHER GAP IN KNOWLEDGE, DEVISE PROCEDURES FOR MONITORING EDUCATIONAL KPU IN PRIVATE INDUSTRY.

   The 1975 DATABOOK could not report on funds, institutions, or personnel in private industry. In general, corporations regard information concerning the extent of their educational KPU activities as proprietary; they believe that such information has market value for their competitors.

   The National Science Foundation sponsors an annual survey of private industry R&D expenditures, but the educational R&D fraction cannot be distinguished.

   NIE's prospective study of institutional KFU performers will seek to identify performers in private industry as well as other sectors. Assuming a high correlation among funding, performers, and activity, estimates of KPU performers in private industry may serve as surrogate measures of the unobtainable funding and activity data.

7. COORDINATE DATA COLLECTION WITH THE GENERAL MONITORING PROGRAMS OF OTHER AGENCIES (NCES, NSF, OMB, GAO, etc.).

   A first step in coordination is the compilation of a list of educational KPU monitoring variables already included in the general monitoring programs of other agencies, annotated to identify discrepancies in interpretation of each variable between NIE and the other agencies. Schedules of data gathering should be noted, since, barring NIE data gathering initiatives, the cycle of data gathering for each variable establishes its timeliness for NIE purposes.

   Whether variables can be redefined and whether data gathering schedules can be amended in the general monitoring programs of other agencies to meet NIE needs is an empirical question. One "test case" should be NSF's categorization of R&D funding and personnel, which presently reflects obliquely on educational R&D in NIE's interpretation of the term. The National Research Council's categorization of fields in its annual survey of doctorate recipients is also less useful to NIE than it could be with small changes in the definition of categories.

   An inevitable monitoring variable is level of funding for each educational KPU task. Presently, NIE interprets the various categories of funding midway between the "OMB perspective," which counts educational KPU components within programs of other major focus, and the "NSF perspective," which assigns all funds in such programs to the major focus (e.g., an

educational research component in a health professions training program is assigned to the category of "health" along with other funds in the program). Without expecting to change the OMB and NSF perspectives as they appear in reports of those agencies, NIE may be able to acquire primary funding data from OMB and NSF for secondary analyses that complement NIE's midway interpretation.

8. RETAIN THE FLEXIBILITY OF UNAGGREGATED DATA IN MONITORING ANALYSES THROUGH THE USE OF COMPUTER DATA BANKS.

   Generally, only aggregated data will be reported by the monitoring program to agency users, but different users will require different aggregation principles. A computer can infinitely reaggregate data without sacrificing its unaggregated form.

   The computerization of statistical indicators is straightforward, although it has to be budgeted as a front-end expense with gradual pay-back as later analyses are produced more cheaply thanks to the computerization. To an extent that can only be determined by experience, the monitoring program will include indicators that are less computerizable than a series of numbers. Mixed quantitative-qualitative indicators (e.g., State codes affecting dissemination and utilization, prioritizations of KPU tasks by role, descriptions of KPU products) should also be computerized for retrieval under multiple headings as appropriate, using a generic storage/retrieval system like Stanford's SPIRES.

9. AVOID UNREALISTIC PARADIGMS OF IMPACT IN MONITORING ANALYSES.

   With better data on overall system activity, multivariate relationships will replace over-simplified paradigms of R&D impact on the schools.

   We are in a period of healthy reconsideration of the impact of research and development on day-to-day operation of social systems and services (e.g., education, health care, transit). Evidence of impact can be seen, but processes by which the impact comes about are difficult to trace and harder still to predict for new developments. There is a resonable infusion of R&D knowledge and products into social systems and services, just as there is a reasonable infusion of needs and priorities from the social systems into the R&D component, but flows seem to be casual and multideterministic (i.e., if one channel of flow is blocked, another will open). Over-simplified paradigms of R&D impact on the schools are predictions of specific flows that may or may not take place, without reflecting on the merits of R&D knowledge and products either way.

Certain "tactical" recommendations are evoked by the experience of compiling the 1975 DATABOOK. The list of such recommendations progresses eventually to the level of detail found in recommendations associated with individual data series in Chapter 5. Somewhat more general but still "tactical" recommendations are the following:

10. IMPROVE REPRESENTATIVENESS IN MONITORING STUDIES.

    Several data series in the DATABOOK are known to be nonrepresentative of their universes and/or sampling frames. Questionnaire studies of R&D personnel (e.g., Phi Delta Kappa, 1966) suffer both from limited definition of the universe represented and from poor response to the questionnnaire.

    Some data series are drawn from "lists of opportunity" (e.g., lists of dissemination facilities by State) rather than from defined universes and sampling frames. Once these data series are reported, they gain authoritativeness from the reporting itself. Unless a system of reliability/validity codes is developed for each data series, agency users of the monitoring program may be misled by the apparent authoritativeness of nonrepresentative data. The best solution to this problem is to improve representativeness of the data series by fixing up, supplementing, or collecting fresh data.

    NIE's prospective study of institutional R&D performers is an important effort to improve representativeness.

11. USE MULTIPLE MEASUREMENT PROCEDURES TO TRIANGULATE IMPORTANT INDICATORS.

    Methods of triangulating valid estimates from individually weak data series have been developed by Campbell (cf., for example, 1969) and others. Despite concern for improved representativeness, there will be need for a triangulation approach in the monitoring program.

    Some monitoring programs (e.g, Bureau of the Census, National Center for Educational Statistics) think in terms of single powerful measures; they do not have procedures for triangulation nor even operating policies that legitimize the triangulation approach. NIE should draw upon the procedures of Campbell and other "multiple operationists" to routinely improve the validity of weak data series through triangulation.

12. LOCATE MONITORING EFFORT IN THE WASHINGTON D.C. AREA

    It became clear to us as we compiled data series for the 1975 DATABOOK that less of the needed data has been published by

agencies with general monitoring programs than might be supposed. To a considerable extent, NIE monitoring of its KPU system will take place in the offices of other agencies.

The question of whether the monitoring program should be staffed initially in-house or by a contractor has political rather than procedural ramifications, since NIE is well-staffed to carry out the monitoring itself but may prefer to establish a small program at a nearby university to depoliticize the many interagency exchanges that must take place. For example, the Interagency Panels on Early Childhood and Adolescence Research at George Washington University serve as useful interagency buffers in carrying out their monitoring work.

However, because the bulk of extant data on educational KPU rests in Washington files rather than in published sources, it is advisable to locate the monitoring program in or near Washington also.

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